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Plugging a Torpedoed Ship

When a hole is torn in the hull, the apron is unrolled like a carpet and lowered over the side

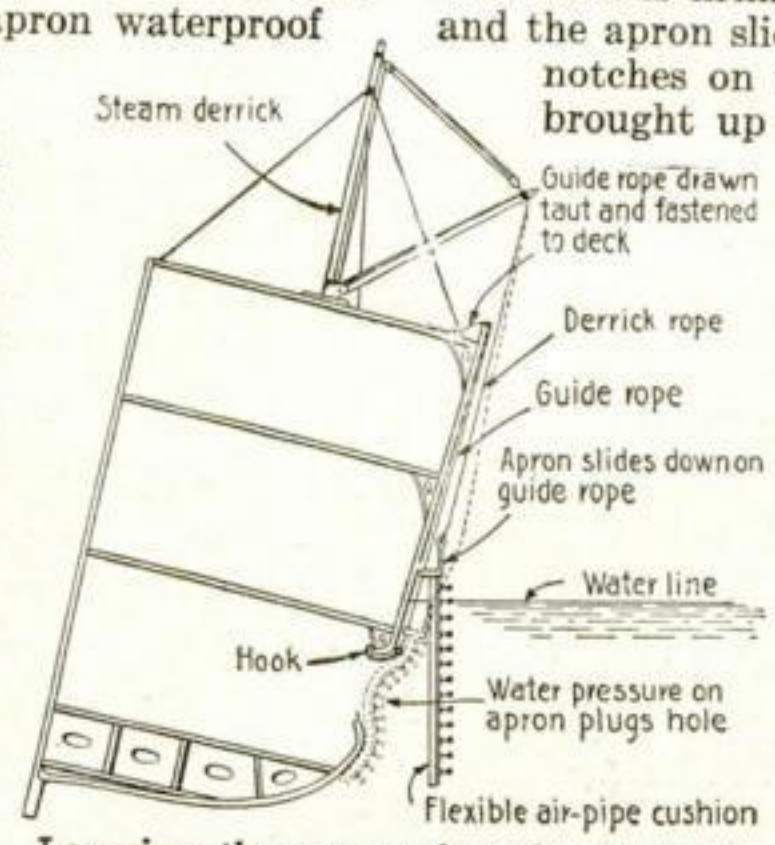
HOW many ships could be saved for the world's commerce if there were means immediately available to plug ugly holes in their hulls, caused by torpedoes, mines, explosive shells and collisions? This is the question which confronted a Wisconsin inventor and he straightway set about to answer it by inventing a metal apron which can be rolled up and carried on the ship's deck and immediately lowered to plug a hole torn in the hull.

The apron consists of a series of bulb tee irons such as are used for deck beams in ships or as a part of the steel framework in large buildings. The irons are held together by means of flexible metal strips bolted to their flanges. Between the metal strips and the angle flanges are strips of heavy tar paper or rubber compound, to make the apron waterproof when it is placed over the hole.

The flexible metal strips which hold the bulbs together permit the entire apron to be rolled up like a carpet and to be carried on the ship's deck on a small wheeled carriage. When a hole is stove in the ship's side, the apron is rolled to the nearest derrick, which may be the mast boom or a small steam winch placed along the side for the purpose. The apron is unrolled and lowered into the water and down to the hole, where the inrushing water sucks it into contact with the hull. A flexible rubber or canvas pipe about eight inches in diameter is attached to the side of the apron. It comes into contact with the ship's hull and extends clear around the contour of the apron. This pipe is filled with air pumped from machinery on board, so that the apron fits the side of a ragged hole so snugly that water can not rush in around the edges.

To locate the hole in the side, two heavy hooks are first lowered by hand and caught in the front and rear projecting sides of the hole. A third and heavier hook is then lowered midway between the first two and it is made fast to the top edge of the hole. The guy rope holding this hook is firmly attached to the deck and the apron slides down the rope until notches on the supporting sling are brought up against similar notches in the upper end of the hook bar. When these notches meet, the apron's downward course is halted directly over the hole and the inrush of the water draws it securely against the hull.

It is doubtful whether the operation would be so simple if the vessel was moving. Moreover, if the hole torn in the hull were of great size, no such plugging device could keep out the water.

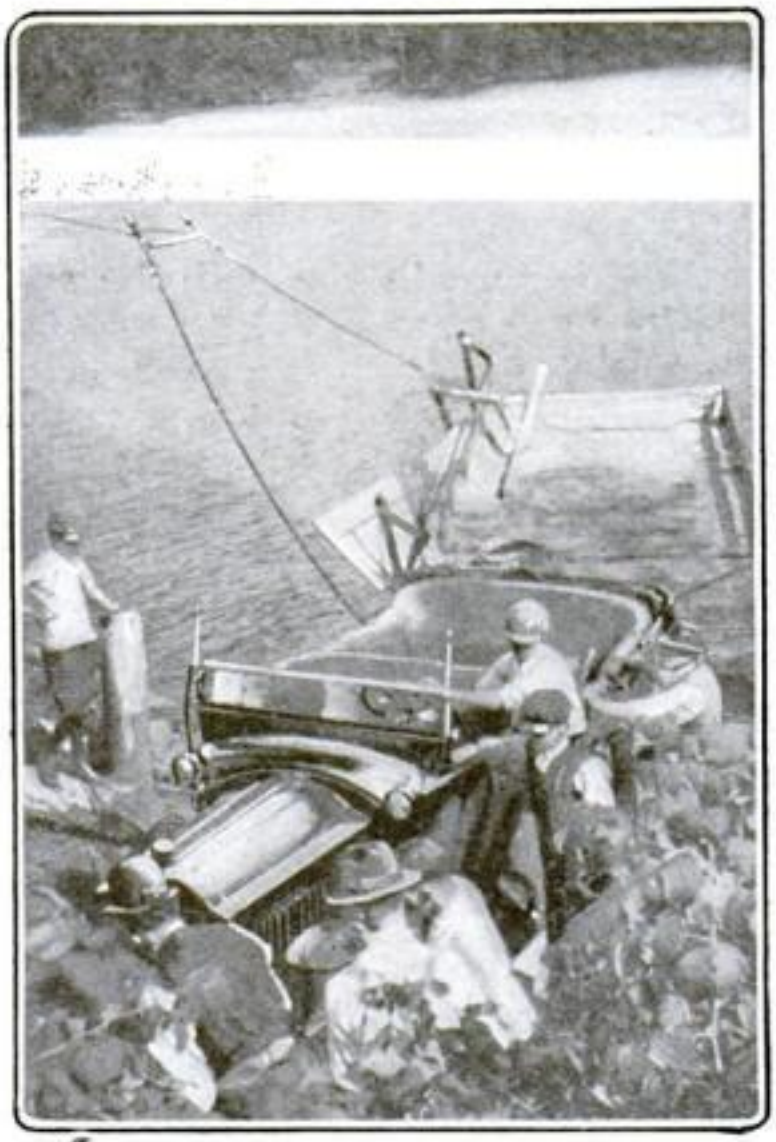


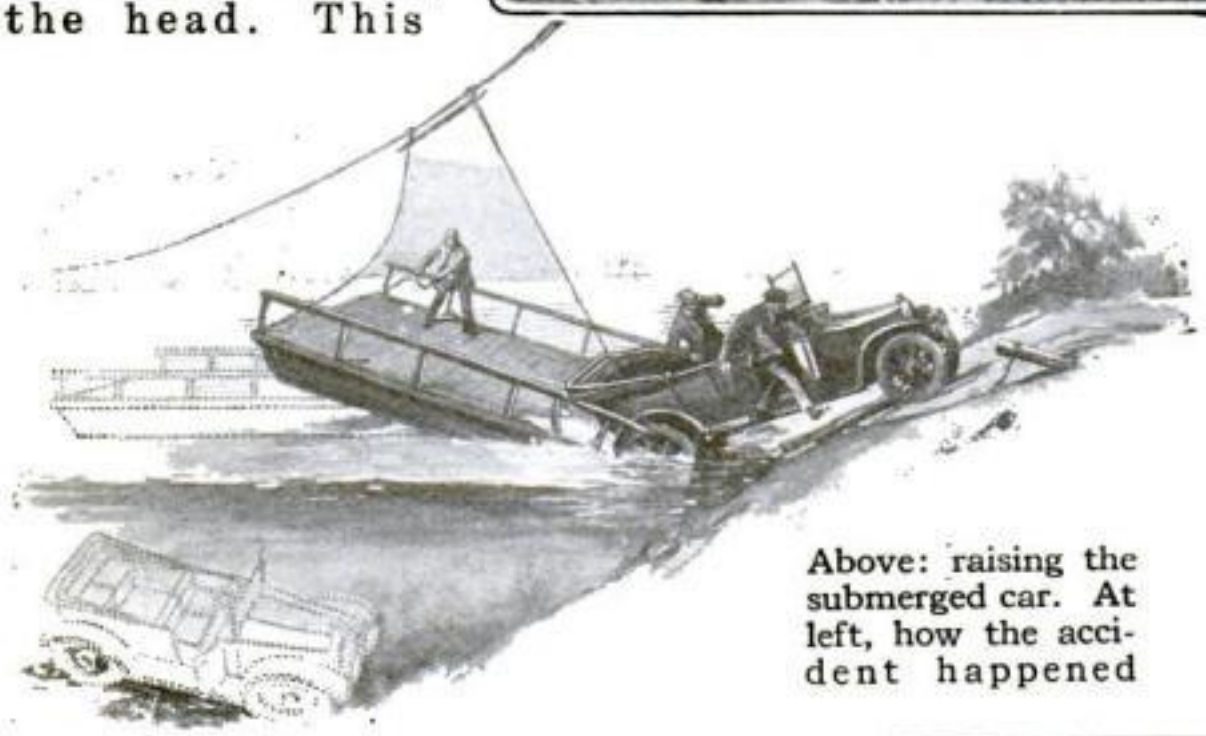
Lowering the apron when the damaged ship has a heavy list. The dotted line shows the final position of the apron when it is placed over the hole torn in the hull

An Automobile Accident Which Couldn't Be Avoided

AN automobile accident which caused considerable interest because of its novelty occurred in Quebec recently. A seven-passenger car partly filled with passengers was ferried across a river on a scow operated by the old overhead cable system. As the scow, with its load, approached the shore it was made fast to a stake and the automobile proceeded to run off. Since the bank at this point was steep, the machine moved slowly, but its front wheels had gone only a few feet before the weight of the car, now shifted to the rear wheels, caused the scow to sink by the head. This downward movement caused the stake to be pulled from its position and the next instant the scow was pushed out into the stream.

With brakes applied, the chauffeur did his best to arrest the backward movement of the car, but it slowly backed into the river, settling on the bottom under fifteen feet of water. Fortunately, the occupants jumped before the car struck the water. A diver was later sent down to fasten a chain to the front axle, after which the car in spite of its weight was brought to the surface rapidly and with very little difficulty.





Above: raising the submerged car. At left, how the accident happened

A Shirt Worth Two Thousand Dollars

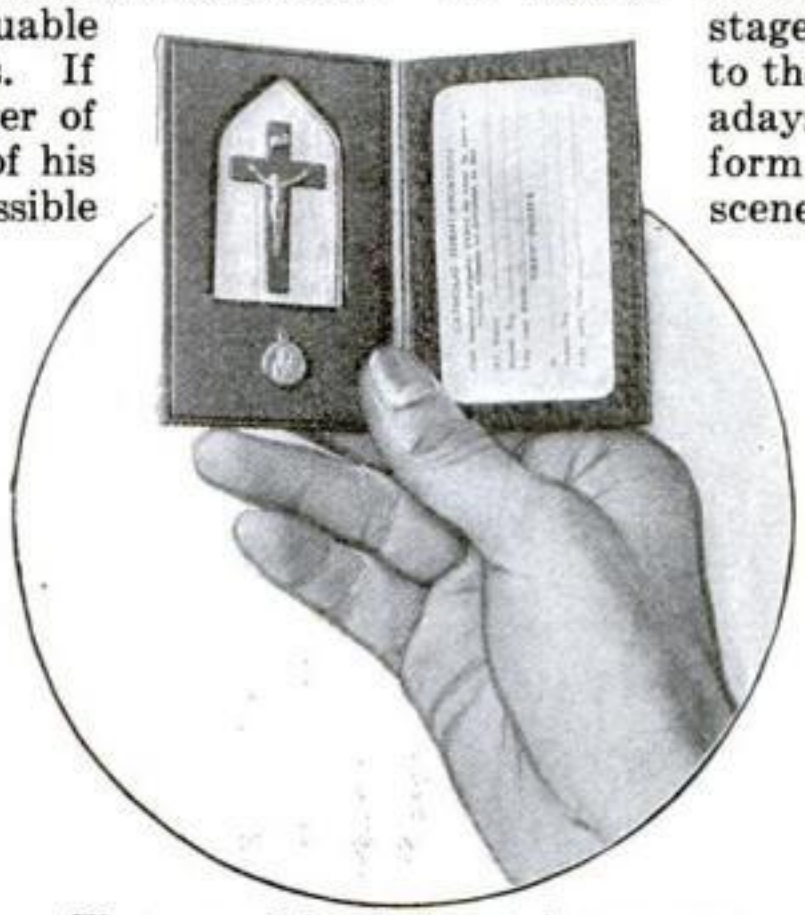
THE head of a laundry in Rochester, New York, a man possessed of imagination as well as of money, recently presented the local Y. M. C. A. with a shirt worth more than its weight in gold. It was nothing but an ordinary, white, stiff bosomed shirt. No costly studs were planted in its buttonholes, but across the front were inscribed words which made it a check for two thousand dollars to go toward the erection of a big, new Y. M. C. A. building.

Perhaps the donor felt that a suspicious public, its temper as well as its clothes frayed from many uncharitable encounters with steam laundries, needed reminding that even a laundry owner may have a heart.

The president of a laundry presented this unique check to a Y. M. C. A. building fund

A Catholic Identification Book for Mortally Wounded Soldiers

THE illustration shows a neatly encased Catholic booklet which is considered especially valuable to all Catholic soldiers. If wounded and in danger of death, the last rites of his Church are an inexpressible comfort to the Catholic soldier. This booklet contains prayers which may be said by a comrade in the Faith, if no priest is within call of the brother in need. A crucifix and a scapular medal, which when blessed, bring the indulgence to those in the shadow of death, are also fastened into the case.



The encased booklet contains prayers for the dying, to be said by a lay Catholic in the absence of a priest

The outer page of the booklet gives the owner's name and address, together with the request to call a priest if the owner is helpless and in danger of passing away. In time of serious accident or other emergency, a booklet of this kind is considered invaluable to all Catholics.

Races in Motion Pictures Employ a "Ben Hur" Revolving Platform

THE great chariot race in the production of "Ben Hur" on the legitimate stage is lending its thrills to the motion pictures nowadays. The revolving platform which made the great scene possible is now being used to give realism to photo-plays in which automobile races or horse and chariot races play an important part.

A drum is carried on the platform. On this drum, scenery is painted to represent the different changes of landscape through which the racers pass. An idea of the size of the drum may be gained by comparing it with the trolley car which is passing along the street behind the drum. The camera-man stands on a permanent platform nearby, which is so placed that he can take a side, front or rear view of the races without shifting his camera or wasting valuable time.

The huge platform is revolved by a powerful motor. The scenes representing the changing landscape are painted on the drum around which the thrilling races take place

Why Monkeys Use Their Fists Instead of Their Hands

WHEN next you go to the zoo, watch the monkeys use their hands. Notice how they seize things with their fists. They do not use their finger-ends as we do. While the higher monkeys, such as gorillas and chimpanzees may be taught to use their fingers, they never learn to use them as easily as do human beings.

The monkey is primarily a tree-dweller. It lives in forests and swings from tree to tree, using its hands as hooks with which it grasps the branches. The thumb is not brought into play. Some South American monkeys have lost the thumb through disuse; all that is left of it is indicated by a little lump under the skin.

An educated chimpanzee threading a needle. His thumb is not well developed

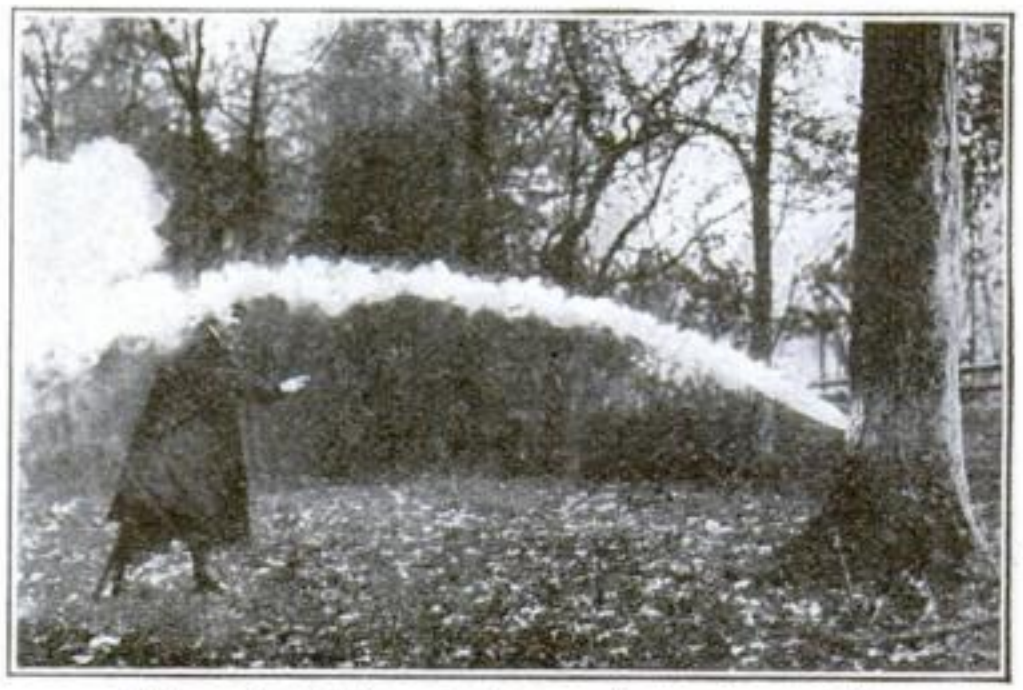
In the higher monkeys the wrist is built like yours. It has the same number of bones. But the monkey has never used his wrist, and so it has lost the flexibility. The monkey can use its feet to better advantage than its hands.

Man, on the other hand, has used his feet so long simply for the purpose of walking, that he would experience considerable difficulty in using them as he uses his hands. Yet, it is amazing how quickly a man can learn to use his toes as he does his fingers. If you don't believe this, just try to write with your toes. At first the letters will be very large and awkward. But with a little practice you will find that you can write with your foot more easily than with your left hand, if you are naturally right-handed. It is an attractive exercise with which to while away an hour. We know you will try the experiment.

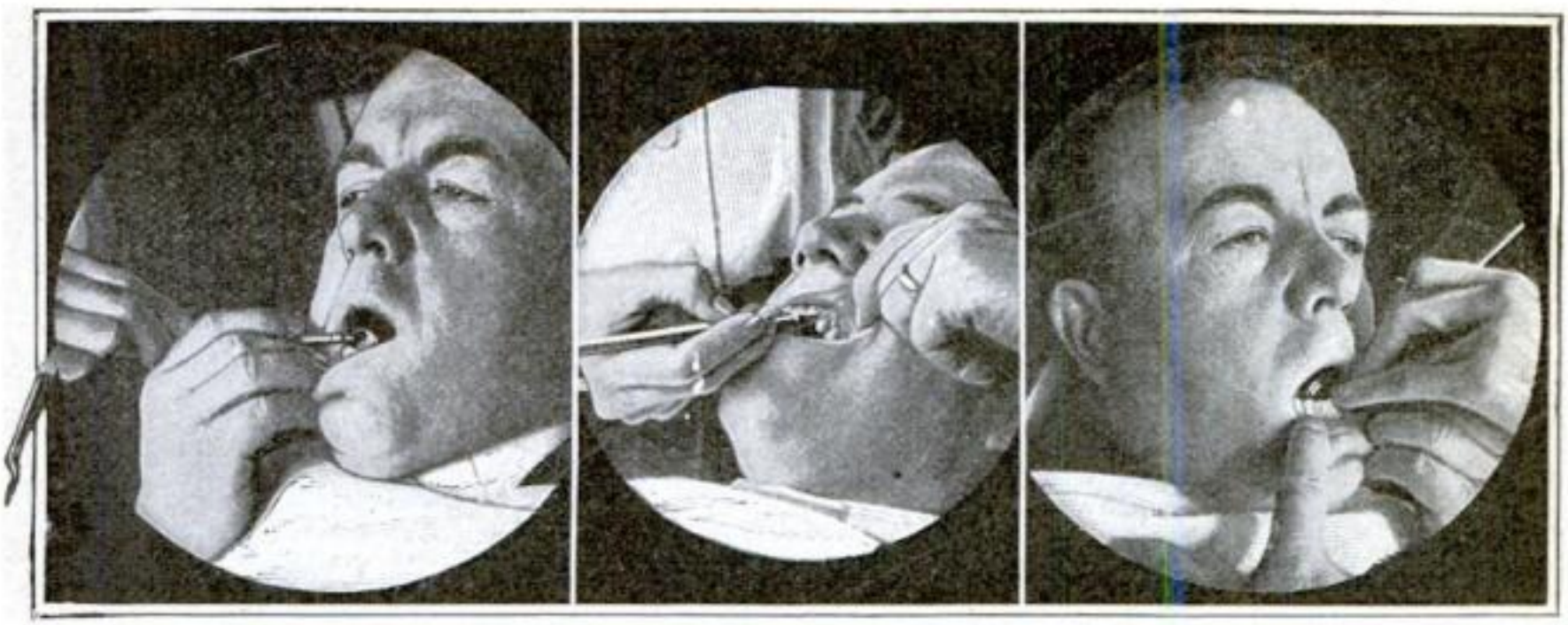
Explosives Are Simpler in Composition than They Seem

HERE, gentlest of readers, we have an object lesson in explosives. The inventor of a particularly new and violent kind is throwing it against a tree in demonstration of the fact that it will not "go off" in the absence of the proper kind of primer. It even may be lighted with a match, and it will burn like a pitch-torch—but no explosion. But should you attempt to set it off with a certain primer, you will arrive elsewhere with promptness and exceeding dispatch.

Most smokeless powders will admit of similar treatment. These features about explosives seem most unusual, until one looks into the physical principles back of their action. Explosion is simply a burning. The quicker the burning the higher the "high" explosive. If an object burns; i. e., is converted into gas quickly, the expansion resulting is capable of exerting tremendous force on whatever happens to contain the object. Here is the force that drives projectiles such tremendous distances.



Throwing this explosive against a tree will not detonate it; a special primer is necessary



Why need a dentist use both hands? Here the patient is assisting him by holding the mirror and lifting up or pulling down a lip so that he can reach the troublesome tooth

A Chance for the One-Armed Veteran—Let Him Become a Dentist

SOON after the outbreak of the war, Mr. Frank B. Gilbreth, known the world over as an authority on shop management and motion study, went abroad for the purpose of studying the industrial employment of crippled soldiers. Nearly every European government has profited by his investigations. He speedily arrived at the conclusion that while false arms and hands were pleasanter to the sight than mere stumps and while they might even reproduce mechanically with remarkable fidelity the movements of arm and finger muscles, it was far more practicable to adapt the cripple to his work by teaching him how to utilize what members were still left to him. It is out of the question to ask a poor veteran to supply himself with an expensive artificial arm, and it is humiliating to pension him off and let him while away an idle existence in some parsimoniously conducted soldiers' home while he is still in the prime of life.

Accordingly, Mr. Gilbreth has worked out innumerable methods of enabling a man with a single arm to earn a livelihood. In the accompanying illustrations it is shown that a dentist need not use both hands in operating on teeth. Here the patient assists the dentist. He holds the mirror for him or he lifts up or pulls down a lip so that the dentist may reach a tooth. That this is no theory, Mr. Gilbreth has proven by actual experiment. He has had his own teeth filled in the manner shown, not by a one-armed dentist, because there are none, but by one who had one arm tied behind his back and even one eye blindfolded to prove Mr. Gilbreth's point. In a later issue, POPULAR SCIENCE MONTHLY hopes to take up these investigations of Mr. Gilbreth's more extensively.

An Eight-Day Watch Tells the Date and the Day of the Week

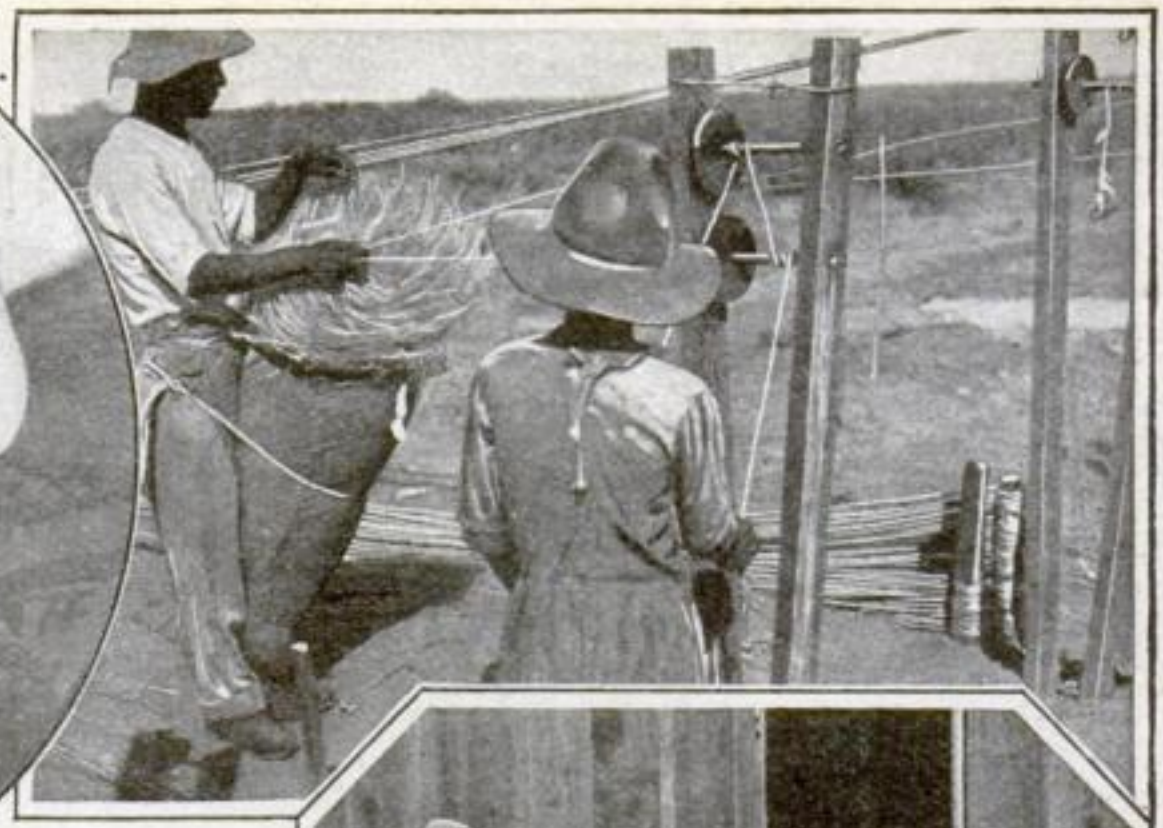
THE accompanying illustration gives another example of Swiss ingenuity in watchmaking. The watch is little larger than those of standard American size. Yet by coiling the thin spring around the interior wall of the case, sufficient energy is stored in it to run the mechanism for eight days. By adding several more gear arrangements to the watch, two extra hands are provided which point out the day of the week and even the day of the month.

A watch that needs winding only once in every eight days

How Man Makes Rope and

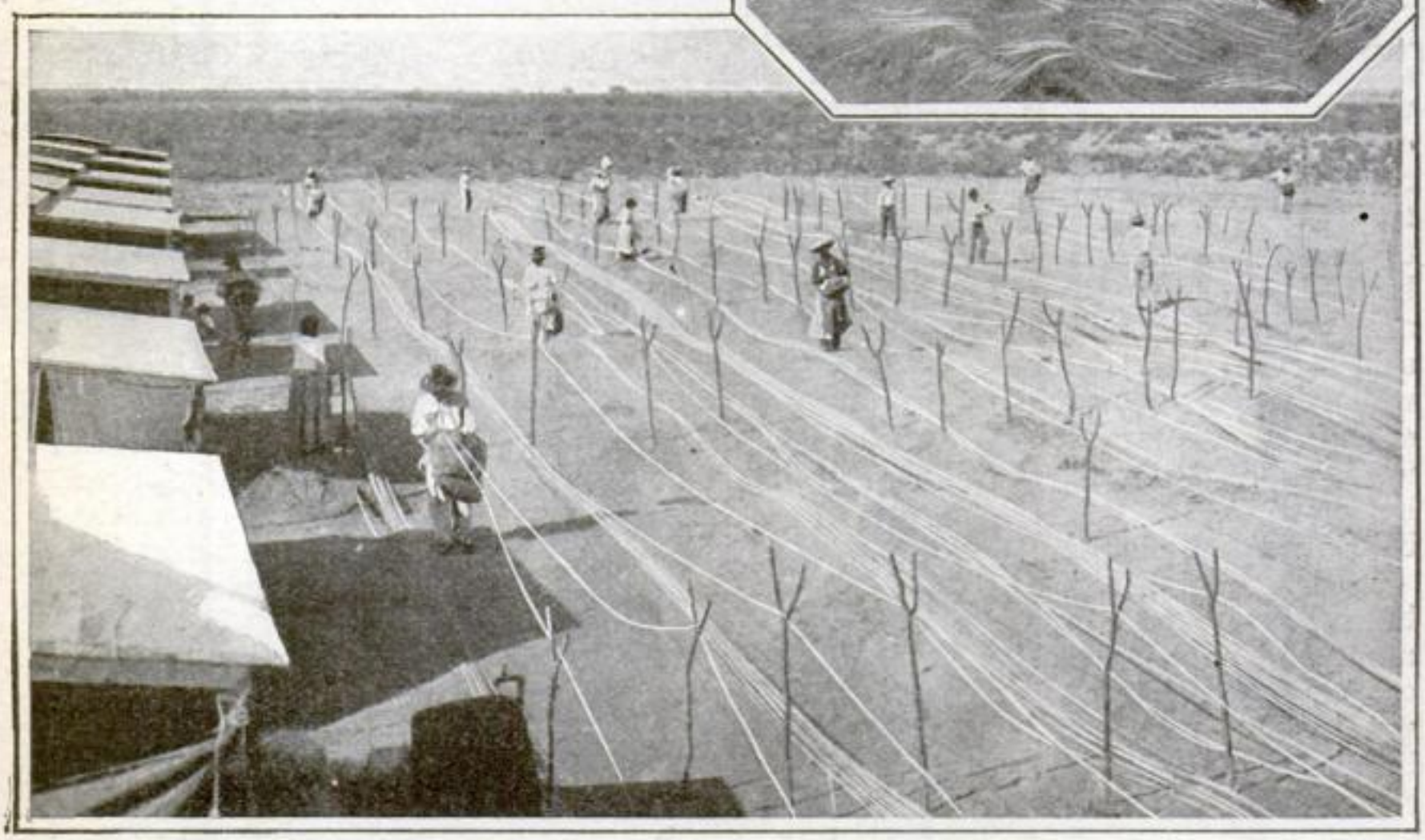
Photos
© Int.
Film Serv.

The plant that Don Juan, here, is holding, will eventually become part of a rope. Sisal and Manilla fiber make our rope and twine



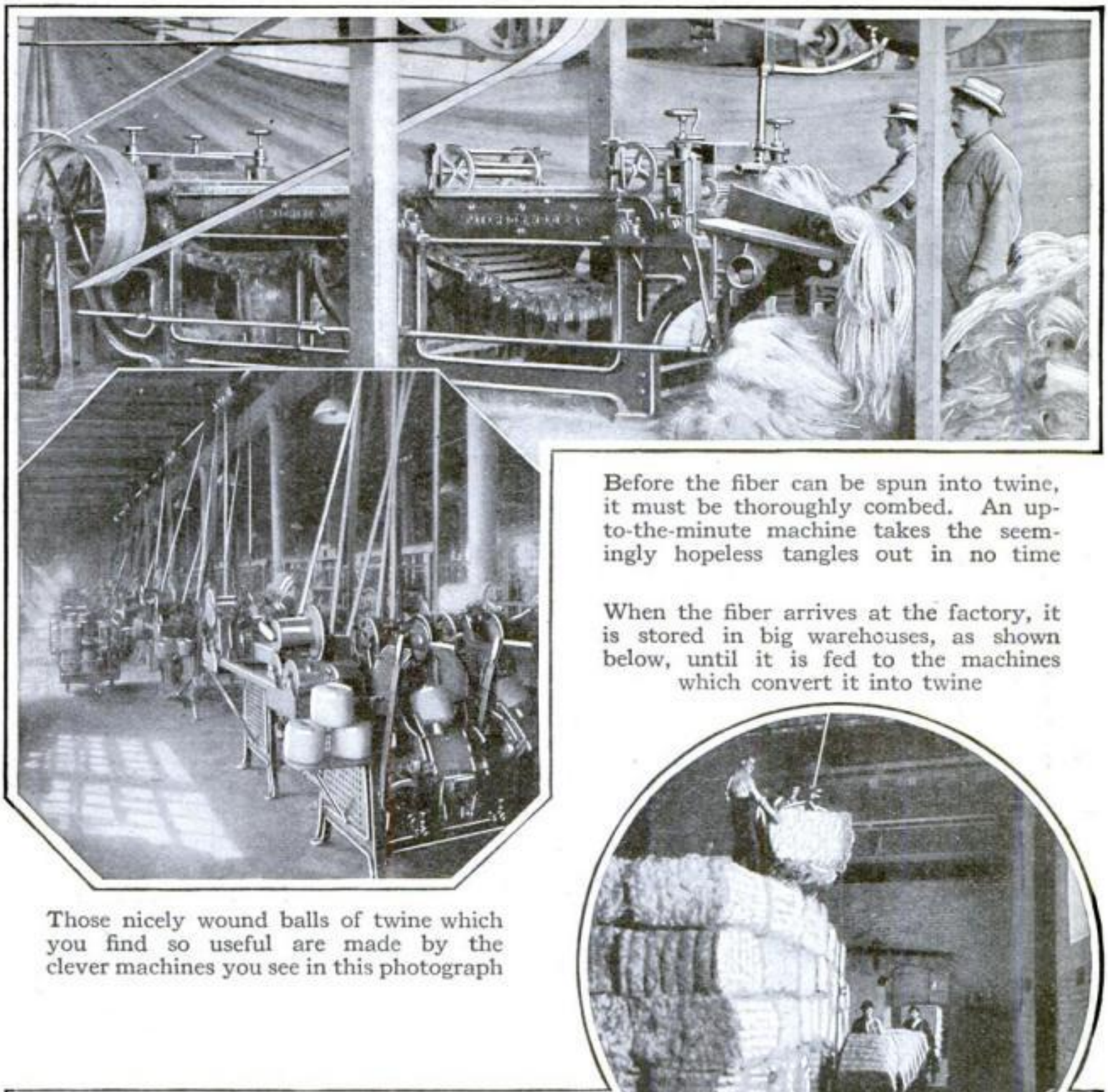
A bag of fiber being made into rope right on the plantation. Note the old-fashioned wooden spindles these rope makers are using

After the fiber has been dried and combed, these men pick it up, a few strands at a time, and separate it to keep it from sticking together



Rope workers busy on a tropical rope plantation. The long strands of rope are stretched over forked stakes that they may be thoroughly dried and bleached by the hot sunlight

Twine by Hand and by Machine



Before the fiber can be spun into twine, it must be thoroughly combed. An up-to-the-minute machine takes the seemingly hopeless tangles out in no time

When the fiber arrives at the factory, it is stored in big warehouses, as shown below, until it is fed to the machines which convert it into twine

Those nicely wound balls of twine which you find so useful are made by the clever machines you see in this photograph

The fluffy strands of fiber being run through spreading machines which must prepare it carefully before it is ready for the spinning machines. Note the length of the strands

Jonah's Miraculous Gourd Was Not More Wonderful Than These Which Grow on a Farm in New Jersey

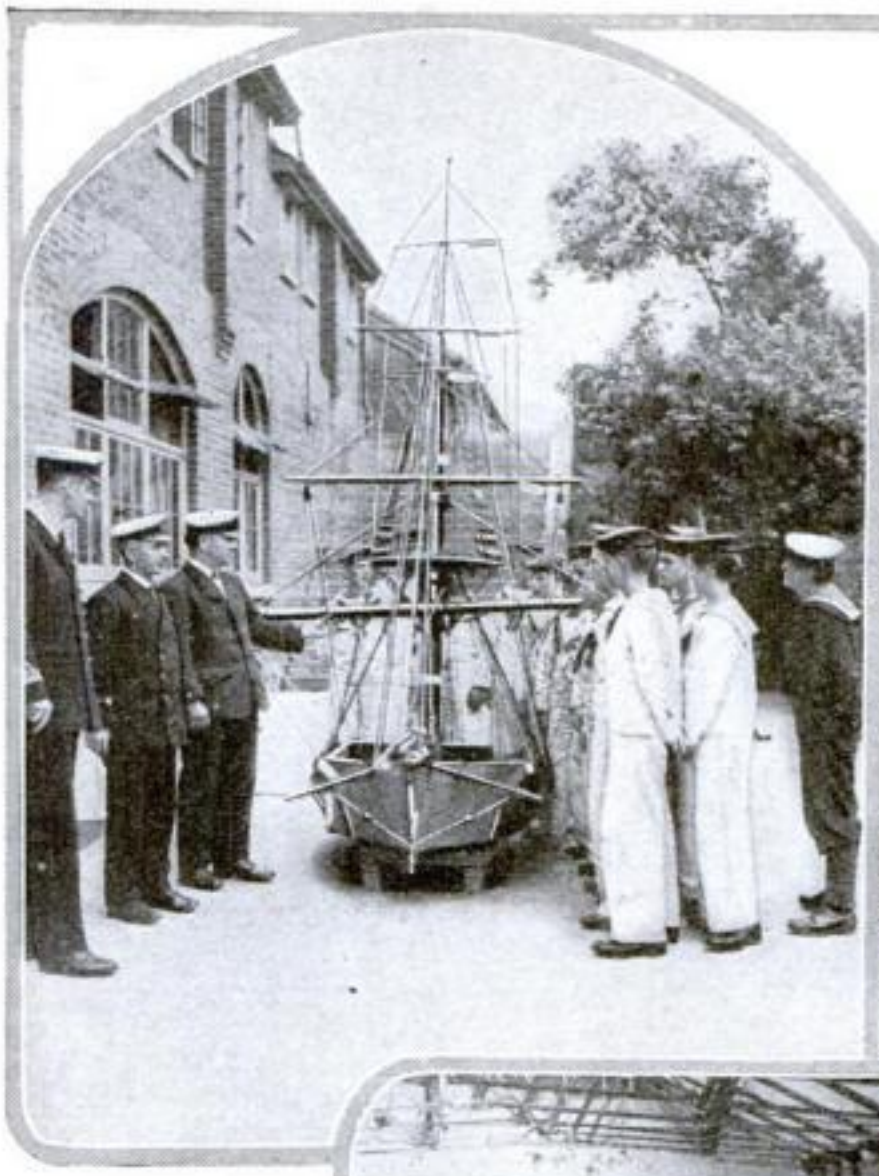
A sugar bowl and spoons made from "dipper gourds." By careful crossing of varieties the resultant vines are made to produce strange fruit

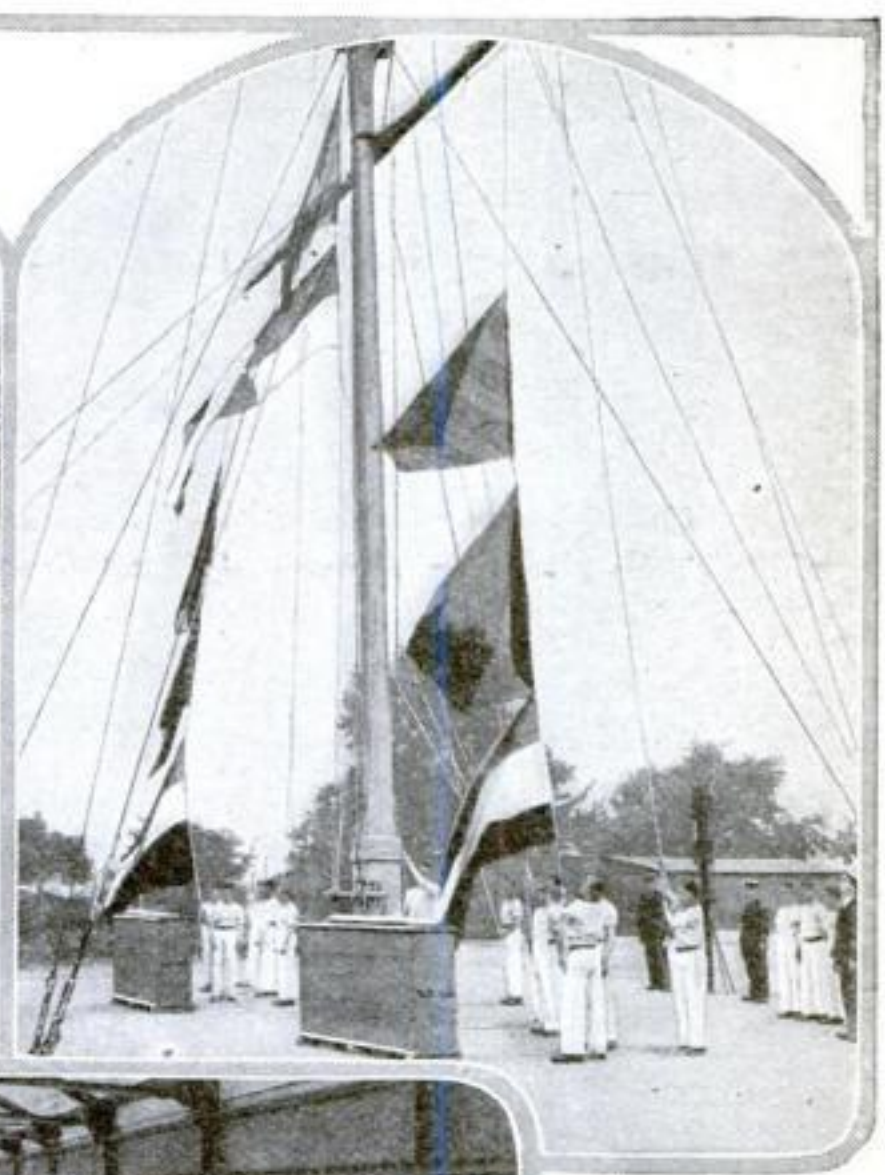
These fortunate small boys needed no expensive baseball equipment. Their bat and balls were picked from the gourd vines

Smoking set, lamp, and gourd on which guests register. All these photographs were taken on Mr. E. E. Wilcox's large New Jersey farm

A gourd labyrinth resembles a strange gymnasium with growing dumb bells, Indian clubs and punching bags. Gourds, although planted in the same way, should not be grown near squashes, watermelons, cucumbers or pumpkins, because useless crosses result

English Jackies Go to School Too

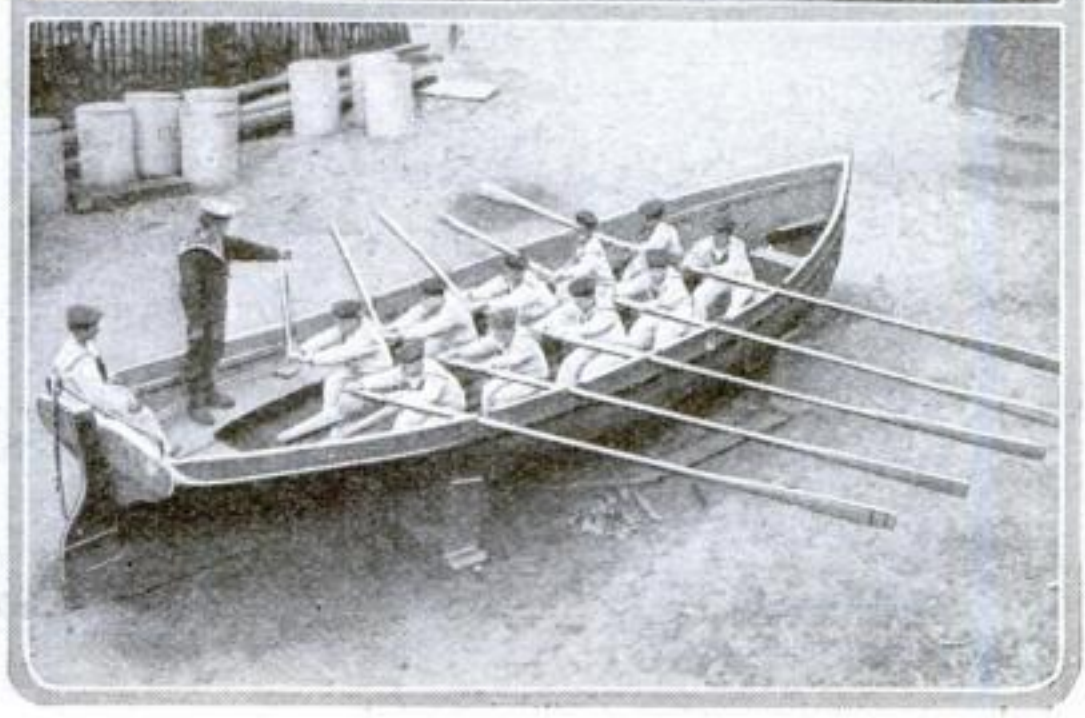




Photos © Press Illus. Serv.

British boys in training for the navy, at Shotley barracks, England. Instruction in seamanship by use of a model sailing vessel of good size is being given

Flag signaling is important in the training of the British Jackie. He must be able to read the messages sent, quickly and accurately, or trouble results

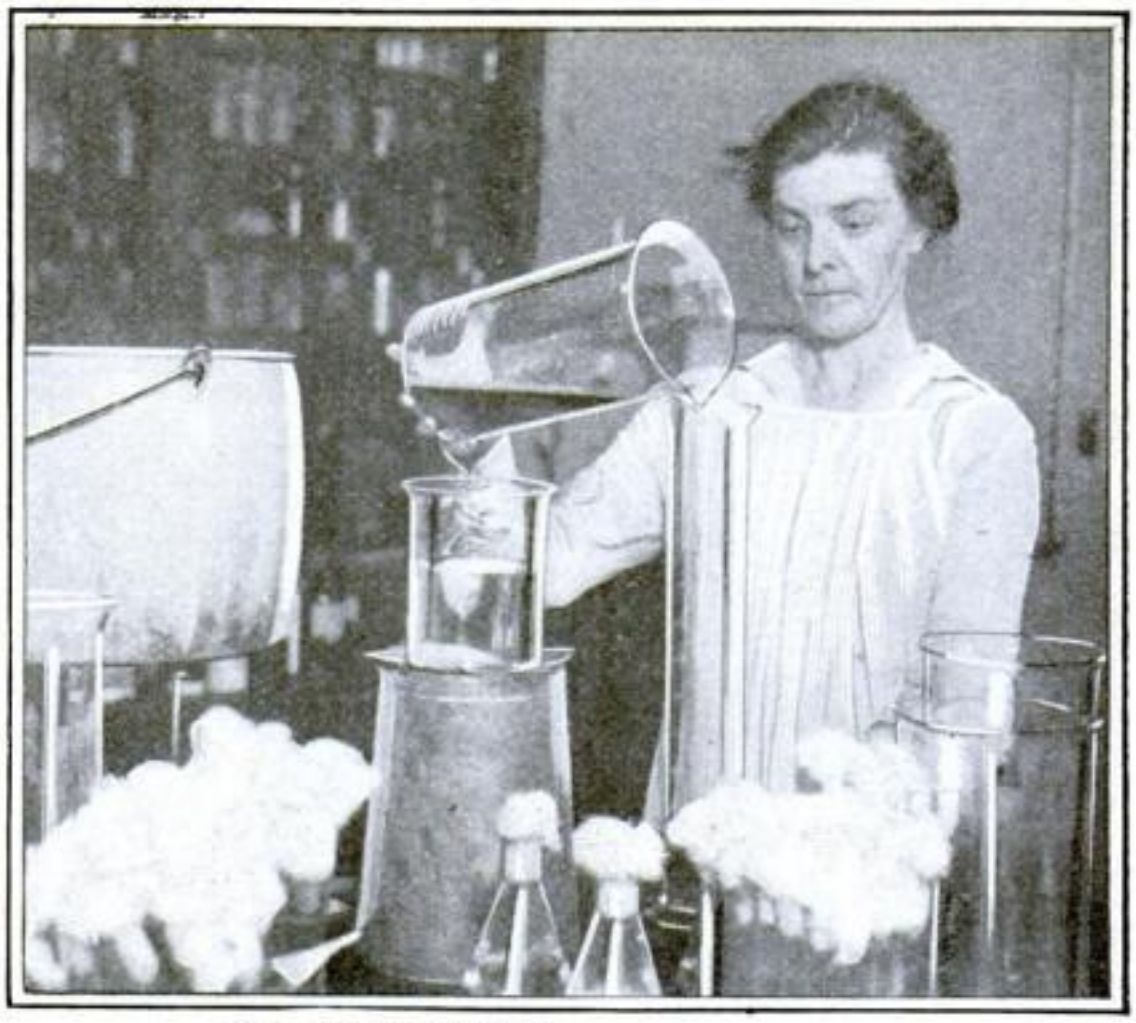


Above, at right: Instruction in gunnery practice with aid of actual guns. Boys learn all details of sighting, loading, and firing—rapidly becoming expert gunners

Young tars receiving their first lesson in oarsmanship. They learn rapidly, as boating is an exceedingly old sport among the sea-loving English of all classes

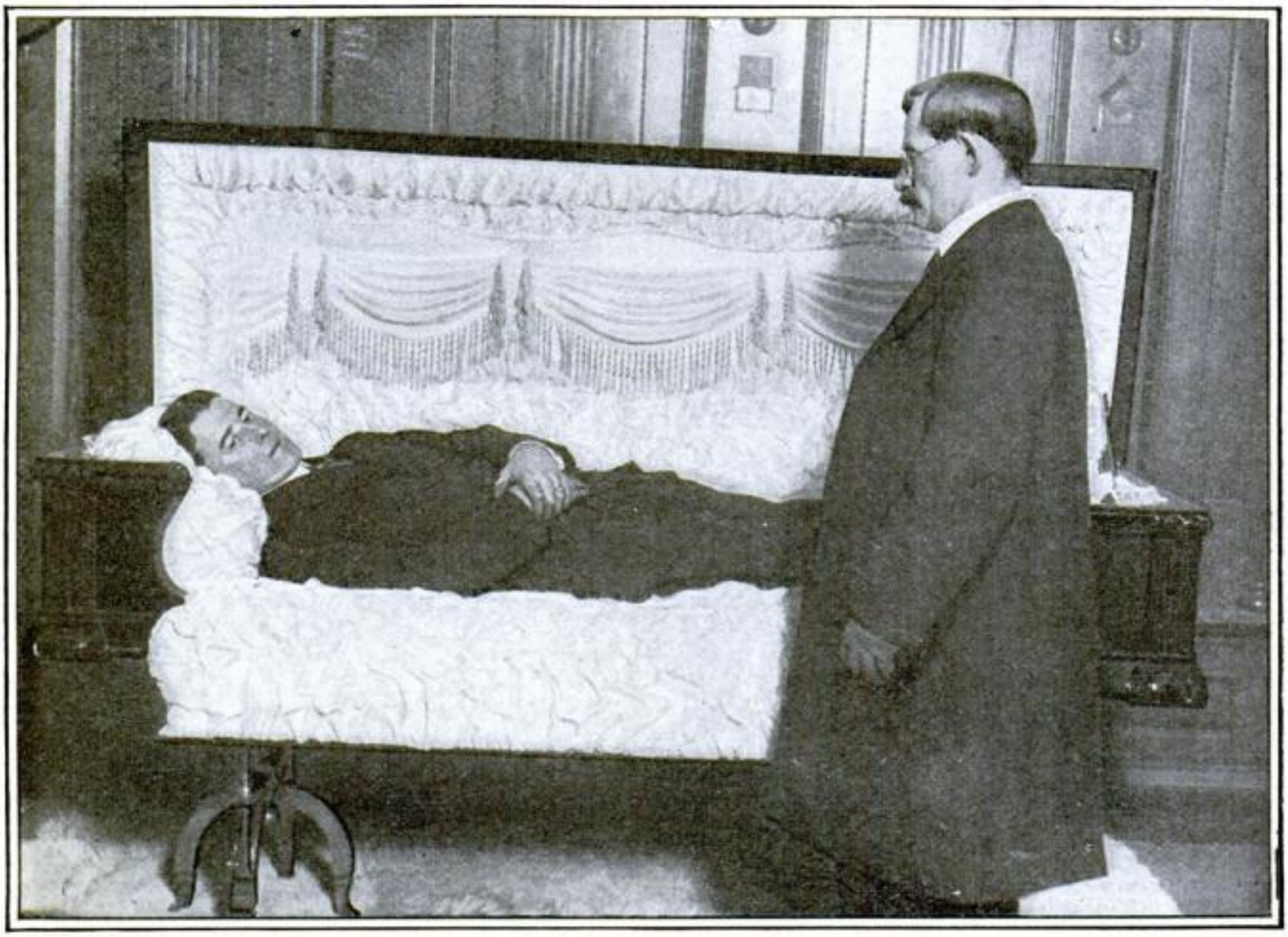
Would You Do It for a Living?

Equipped with a syringe of "germ killer," this man sprays the places where Chicagoians seem to be fondest of expectorating



Photos © Int. Film Serv.

A Chef to Bacteria. Miss Agnes Quirk caters to the dangerous bacteria used in the interesting research work at the Bureau of Plant Pathology in Washington, D. C.



This young man, employed by a Brooklyn undertaker, earns his living by "playing dead." He illustrates the becomingness of various styles of coffins Note his appropriate expression

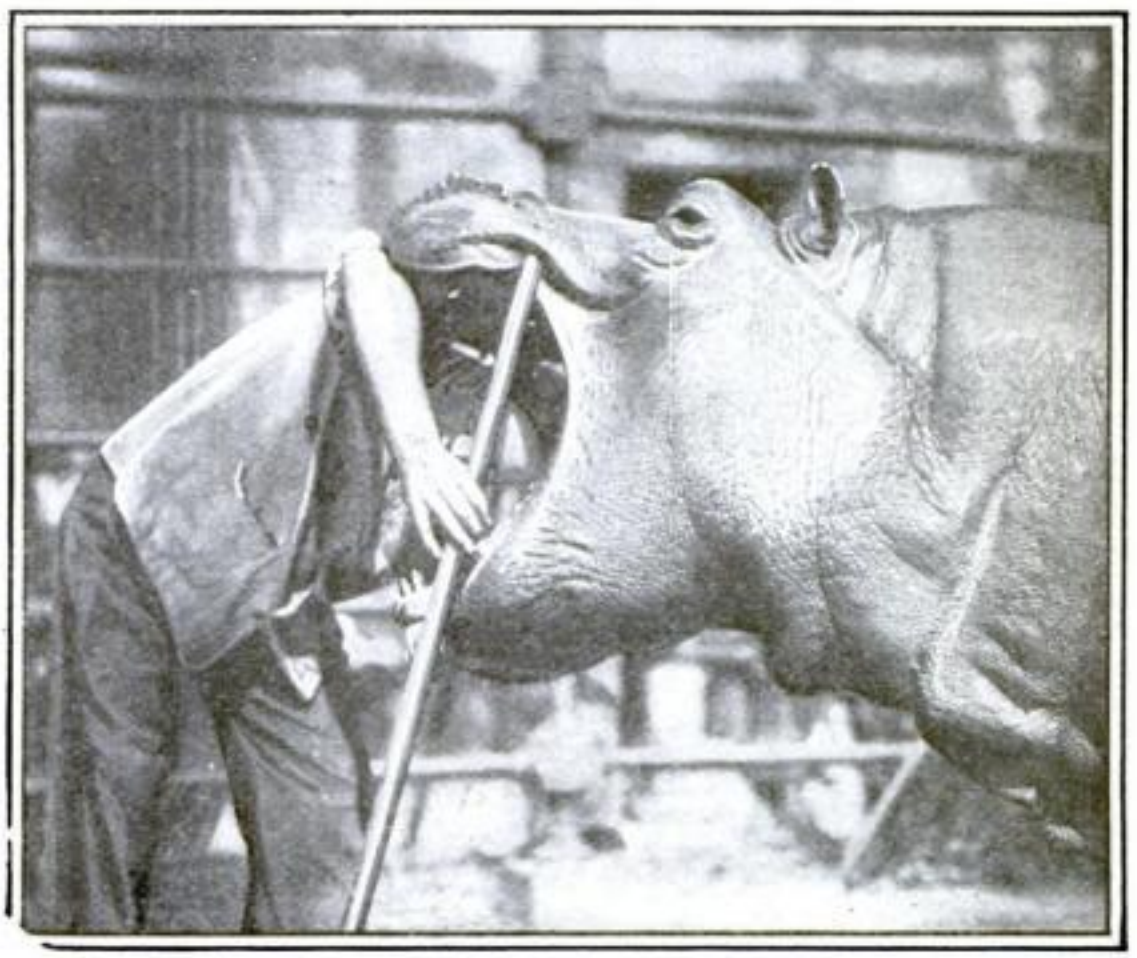
Would You Do It for a Living?

Photos © Int. Film Serv.

A doctor with ten million patients. Miss Rose Murray is swathed in this way to guard against inhaling bacteria while she ministers to torn, backless and otherwise mutilated books in the New York public library

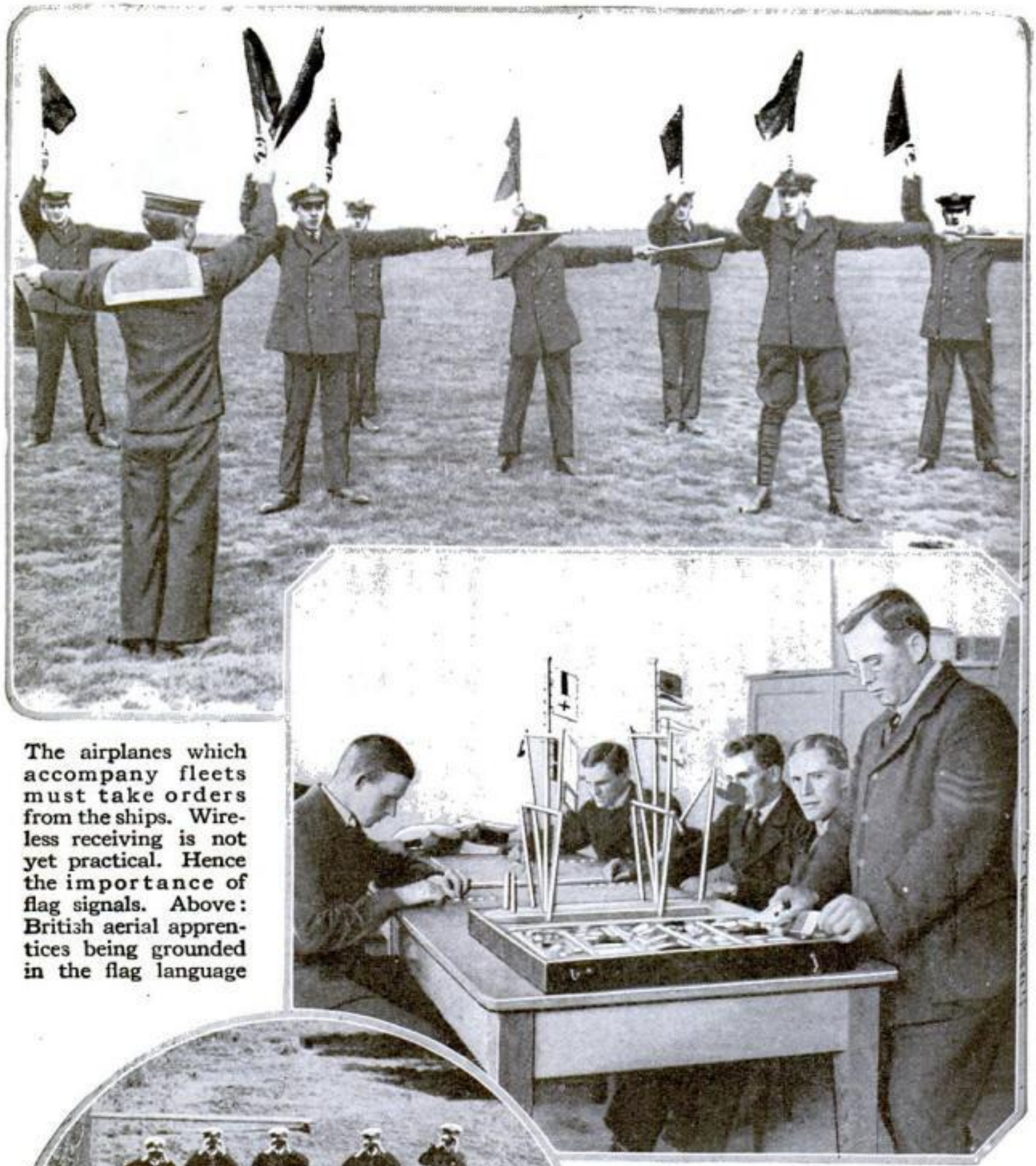
A Daredevil of the Clouds. This perilous trapeze performance is all in the day's work. The performer says he enjoys his job because it keeps him out of doors

Mr. (not Miss) Merrifield, of Wilkes-Barre, Pa., earns his daily bread with the efficient aid of his trusty crochet needle

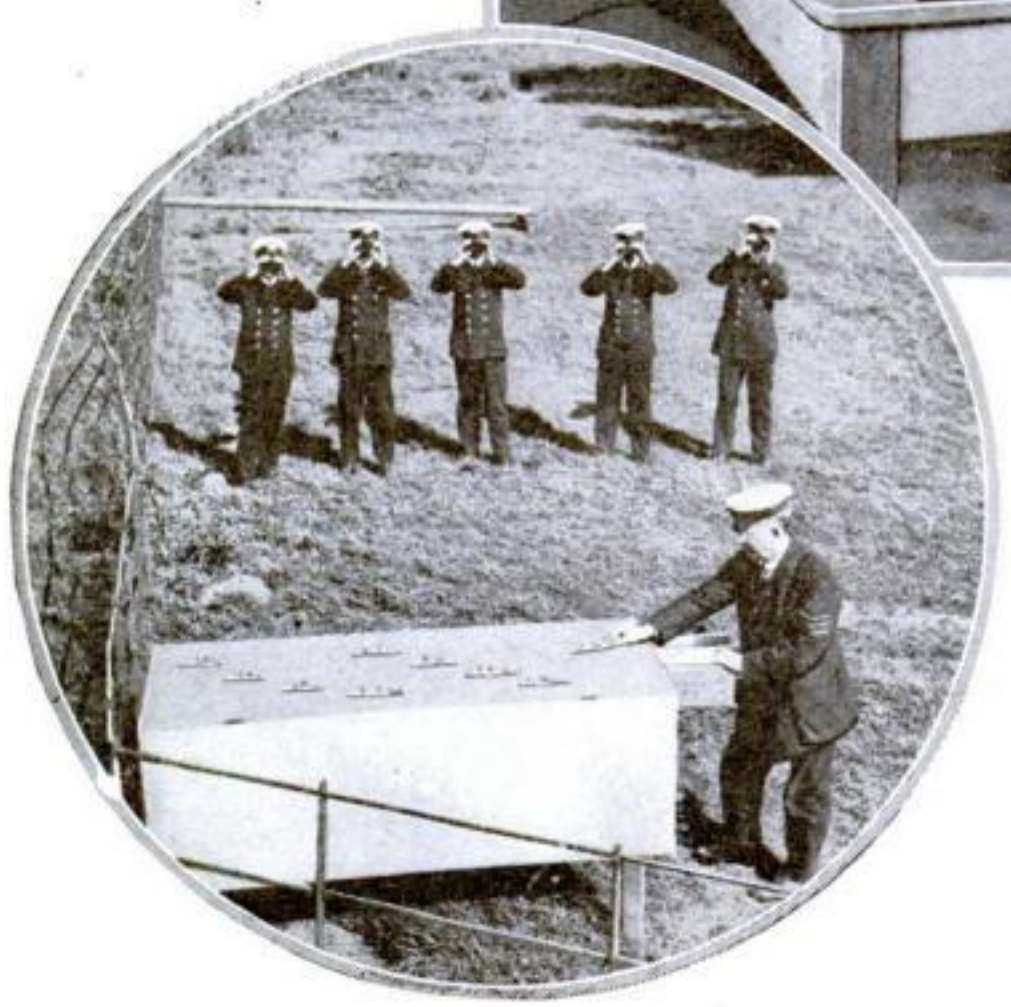


Wouldn't you rather be "on the outside, looking in?" This daring young assistant at the Central Park Zoo is employed as dentist to Miss Murphy, the hippopotamus

Reading Flag Signals from the Sky



The airplanes which accompany fleets must take orders from the ships. Wireless receiving is not yet practical. Hence the importance of flag signals. Above: British aerial apprentices being grounded in the flag language



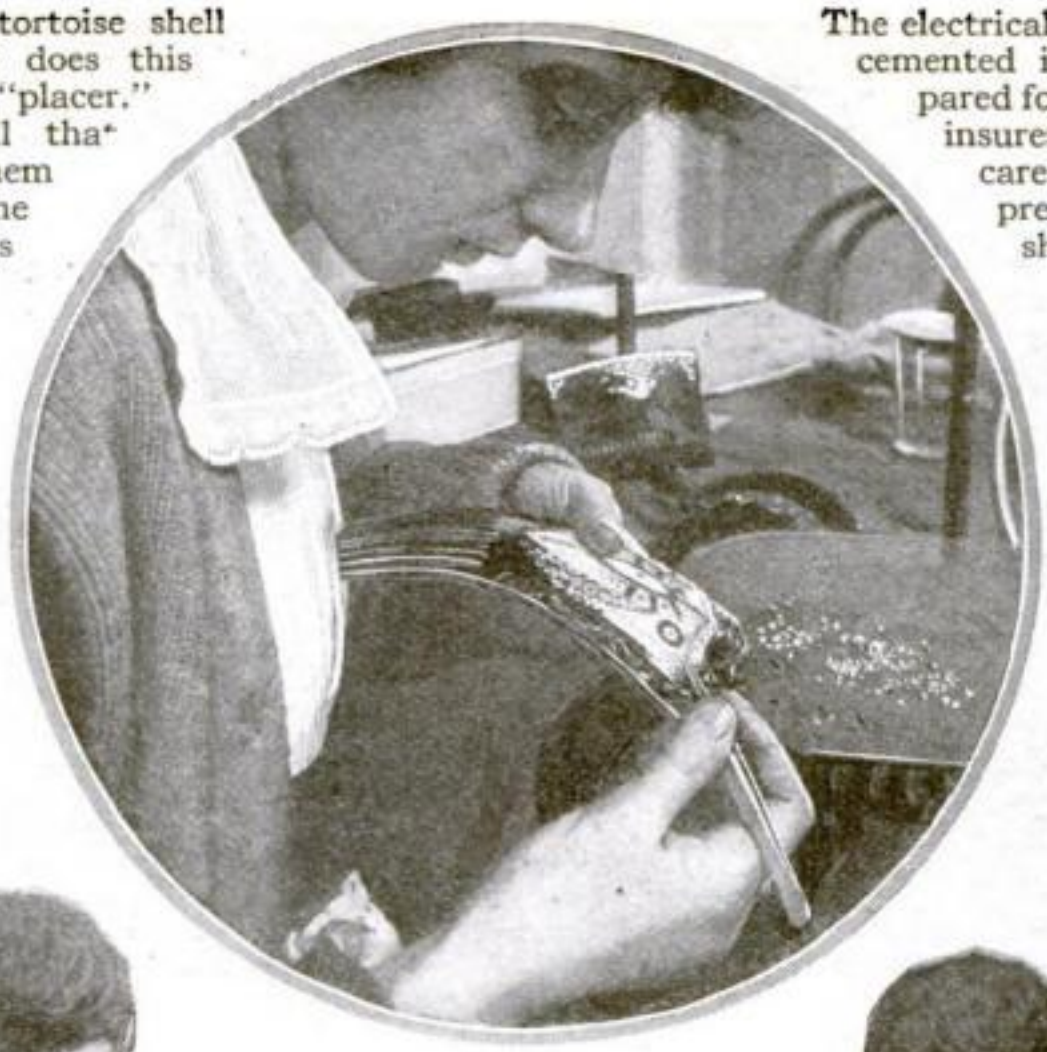
Photos © Underwood and Underwood

A more advanced class. The officer sets a flag signal on the model of a ship's rigging. The students reply to it by moving their miniature squadrons. This exercise is also an excellent training in quick tactical judgment

Students must identify from a distance the models of friendly and hostile ships which are placed on a table painted to represent distance at sea. The hinged board at the back is raised to represent a seemingly vertical background of sky

How Her Jeweled Comb Is Made

Placing tiny jewels in tortoise shell combs. The girl who does this tedious work is called a "placer." The jewels are so small that she cannot handle them with her fingers, so she uses tweezers. The stones must be heated on an electric stove before they can be placed



The electrically heated stones are cemented into the settings prepared for them. This process insures their sticking. Great care must be exercised to prevent the cement from showing. Only the minutest amount can be used. The patterns usually are exceedingly intricate

Drilling the tiny settings for the stones which make the elaborate patterns on the present day jeweled combs. The drill is operated by electricity

This man is working on an aluminum comb. After the brilliants are firmly set, he takes a sharp tool and carves the metal around the jewels

Photos © Press Illus. Serv.

Samples of elaborately jeweled combs and hair ornaments. What young lady would not linger over such an attractive display in one of the shops

The Germans are Coming! Sound Bombs Soar

Photos © Int. Film Serv.

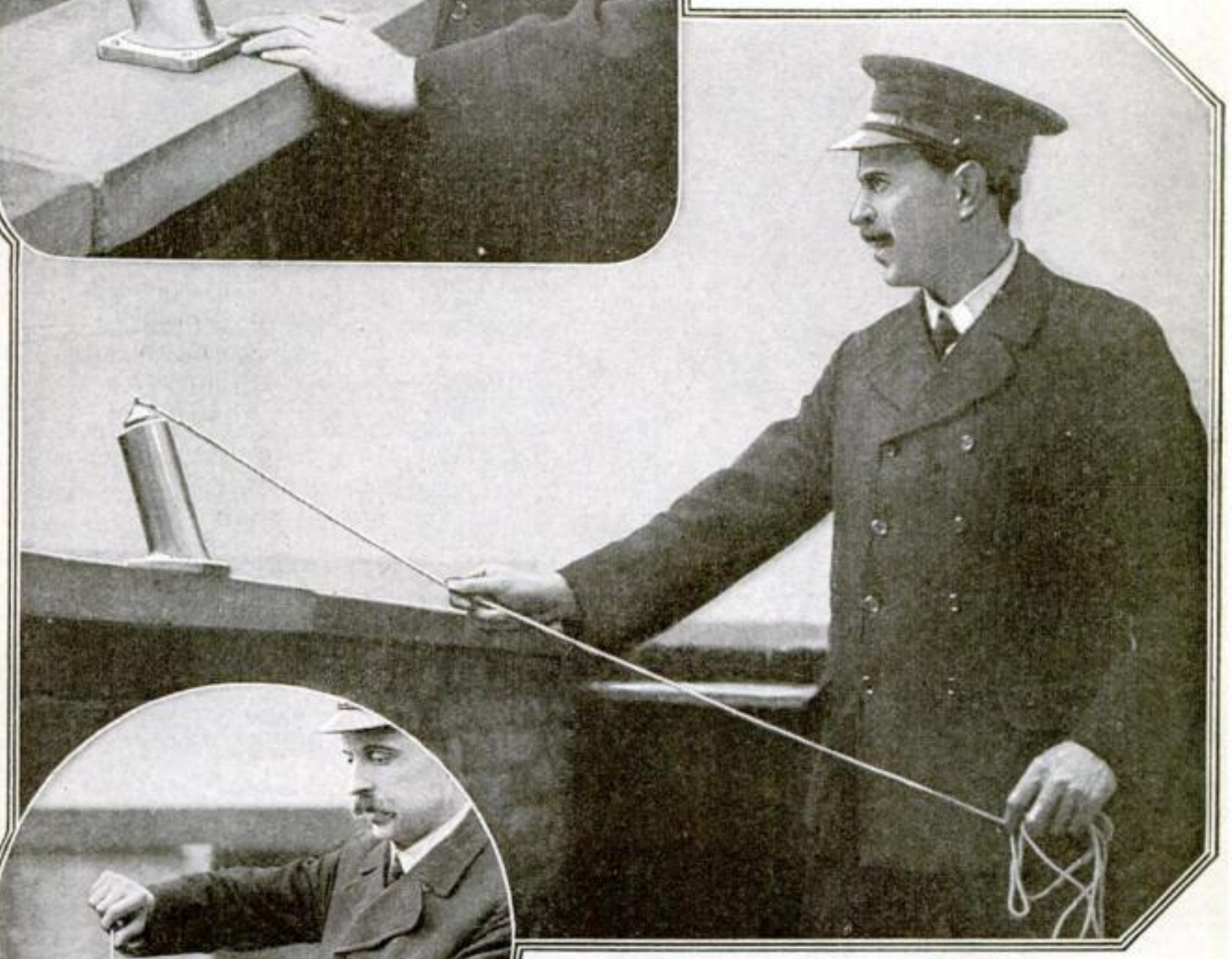
When air raiders approach London warning is now given by sound bombs which rise three hundred feet before exploding. Above is shown the mortar which is used for firing the rockets. They get results

Inserting the time fuse in a rocket before sending it aloft. The bombs produce a tremendous noise which can be heard over great areas. London has come to know this helpful "run to cover" signal

Into the Air to Warn London of Air Raids

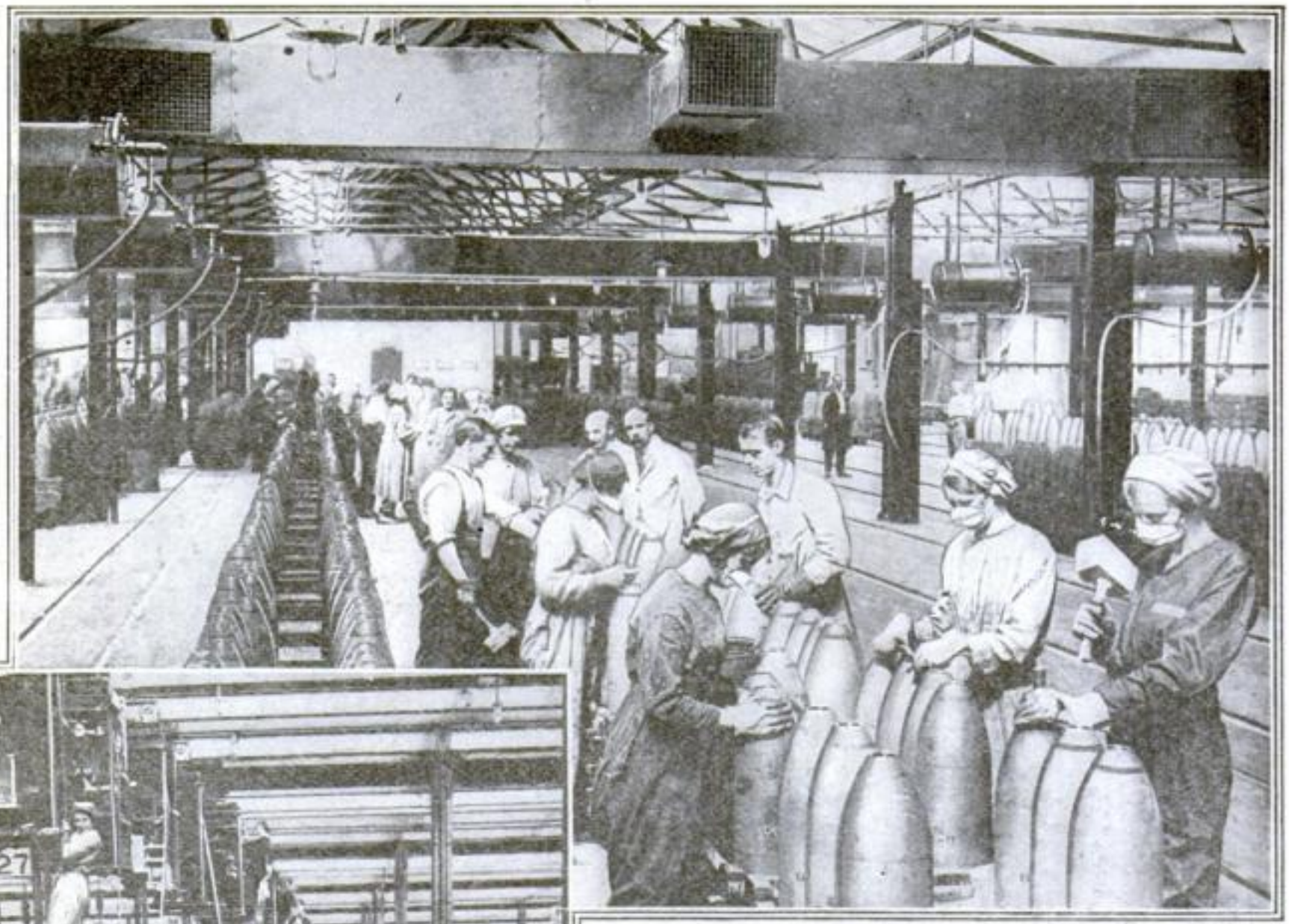
Putting the bomb, or rocket in the mortar. As is evident, the mechanism for firing is simple. It can quickly be mounted on the top of a wall or on a convenient roof

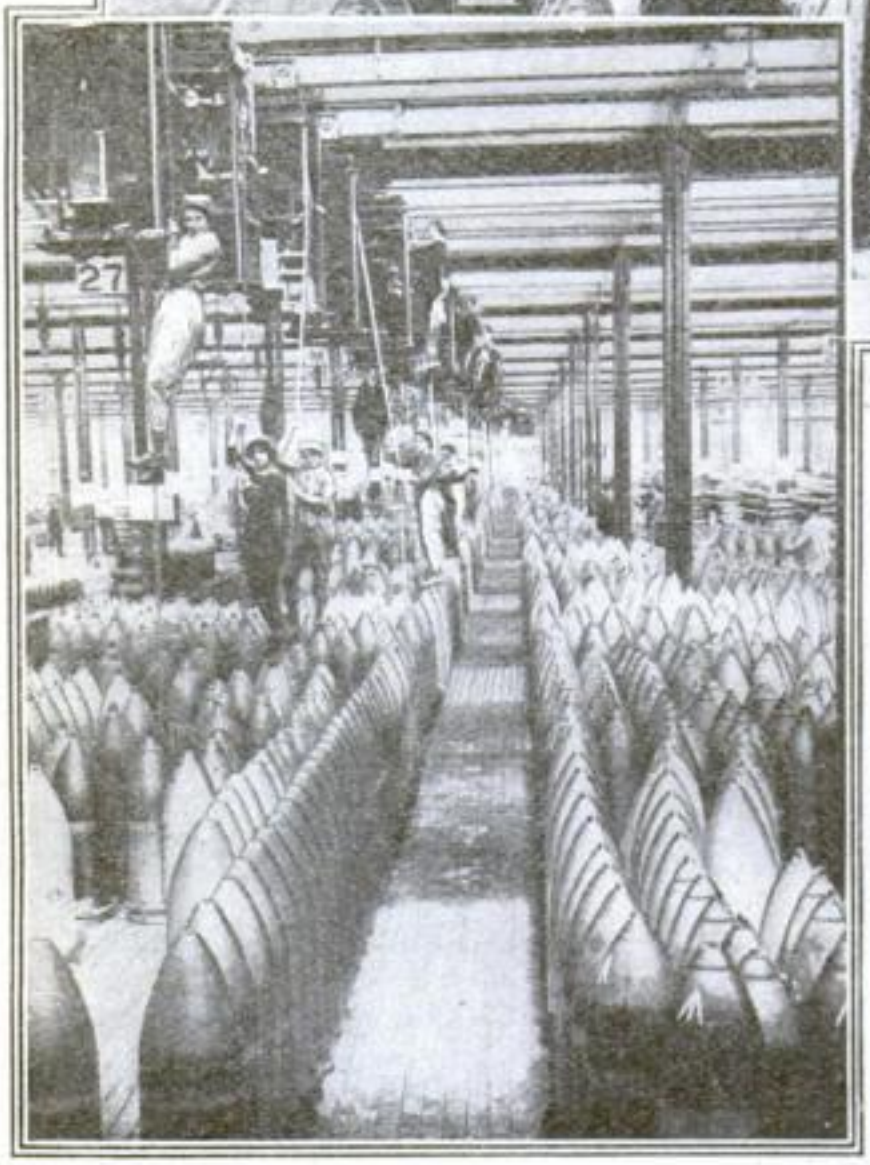
Fire! The operator simply pulls a lanyard attached to the fuse and away goes the bomb high over the city. When many bombs are exploding the noise is deafening



Cleaning out the mortar after firing. Since the mortar is short, this is not difficult. London plans to have smoke bombs for use during the day, so that smoke clouds as well as loud detonations may warn the people

England's Heroines Are in Her Munition Plants





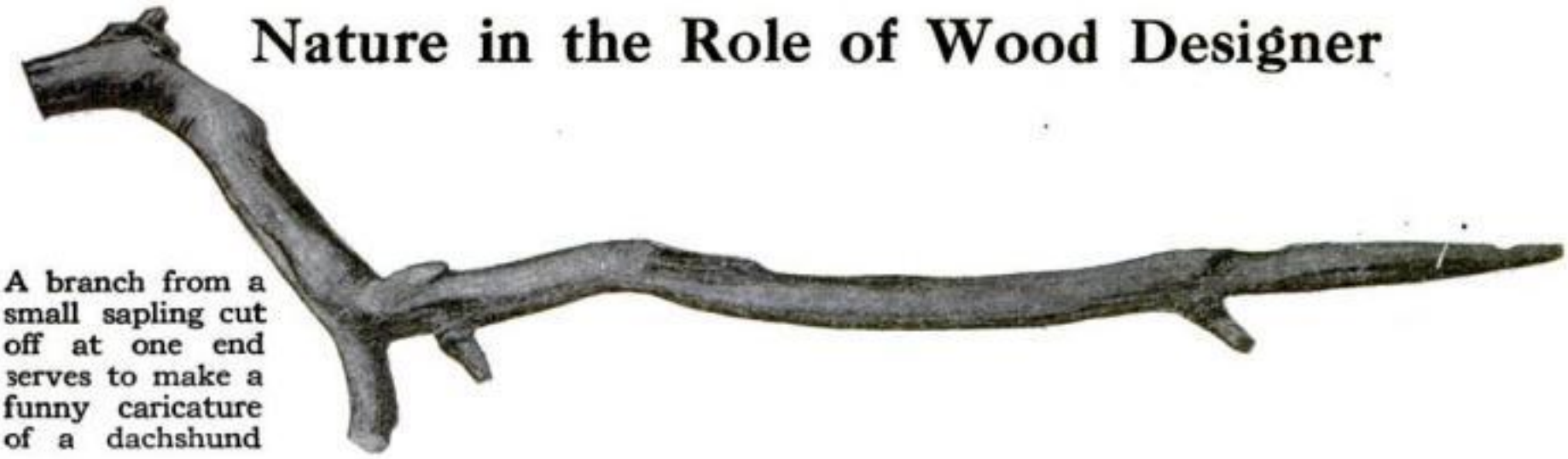
Photos © Underwood and Underwood

Dressed in the familiar garb of the munitions maker and wearing masks to protect their nostrils from the noxious fumes of high explosives, these workers are putting the finishing touches on large shells

Below are shown shells of eight different sizes which England is using against her enemies. A steel ring is placed in the nose of each shell. By means of this, the shell can easily be lifted with an ordinary hoist

Crane girls in one of England's greatest munition plants swinging to the floor from their aerial posts, where they operate a vast network of hoisting machinery. More than eighty thousand British women are now holding positions occupied by men before war altered industrial conditions

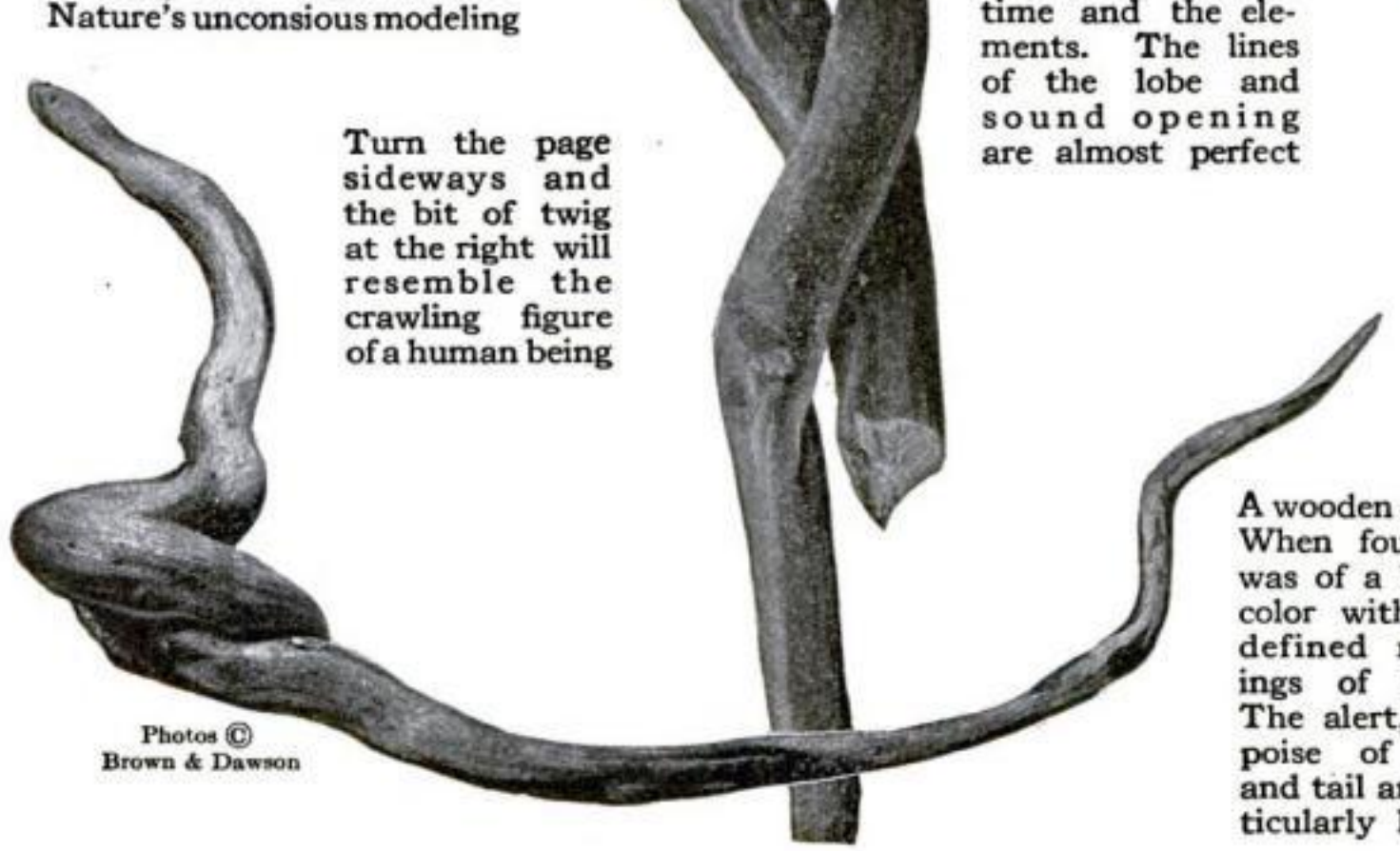
Nature in the Role of Wood Designer



A branch from a small sapling cut off at one end serves to make a funny caricature of a dachshund

A knothole in a section of pine board resembles a death's head. It is only one of many curious instances of Nature's unconsious modeling

This well chiseled ear is the work of time and the elements. The lines of the lobe and sound opening are almost perfect



Turn the page sideways and the bit of twig at the right will resemble the crawling figure of a human being

A wooden snake. When found it was of a brown color with well defined markings of green. The alert, vital poise of head and tail are particularly lifelike

Photos © Brown & Dawson

The home of the Cliff Dwellers, in Mesa Verde National Park, in southwestern Colorado. This is the largest of the prehistoric ruins on the Mesa. The ruins are three hundred feet long and contain about two hundred rooms, including twenty-two kivas, or underground ceremonial chambers. Several of these may be plainly distinguished in the photograph

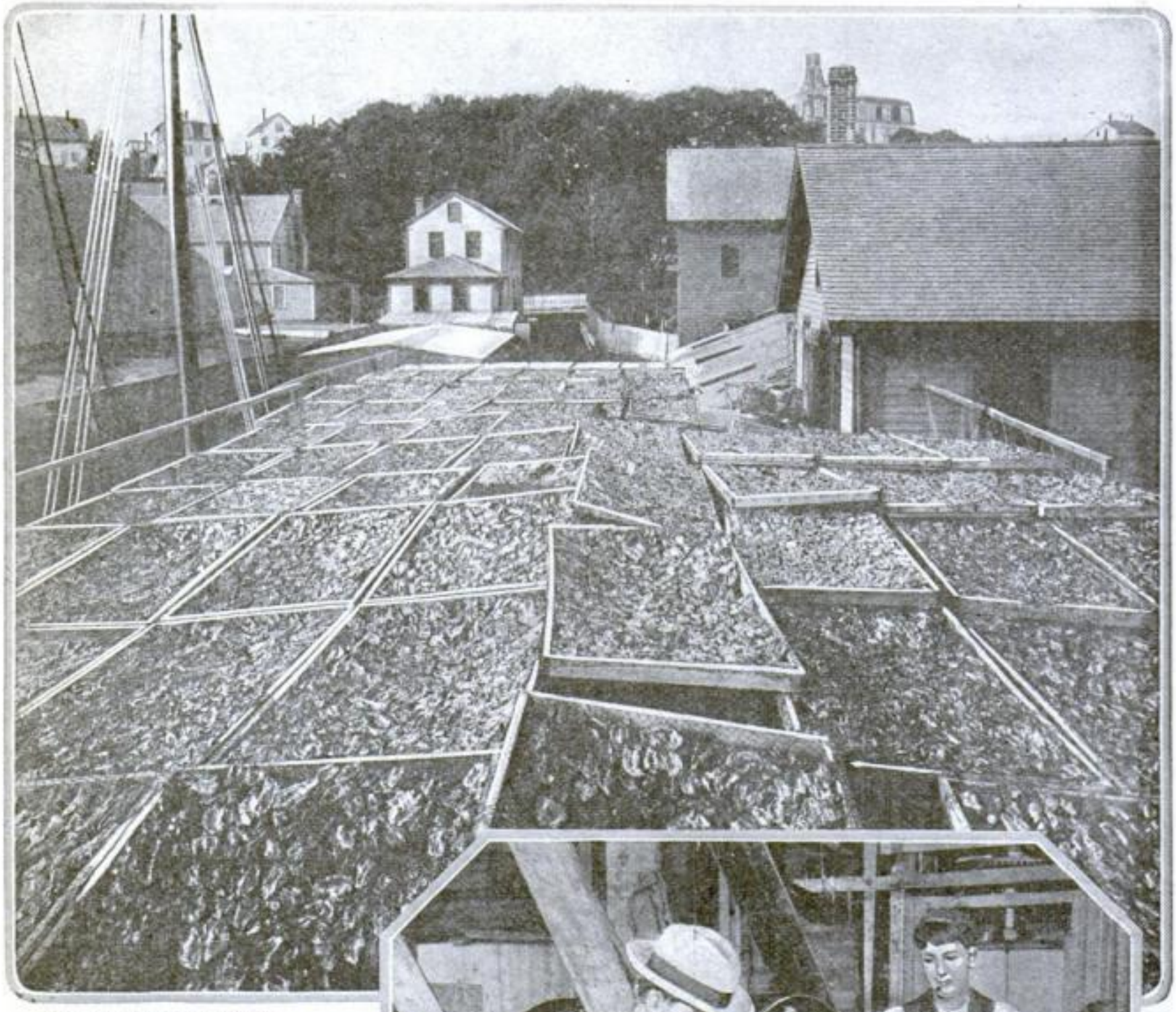
the Cliff Dwellings of Our Prehistoric Ancestors?

Photos © Brown & Dawson

A cliff dweller's house. Discoveries in this region have been remarkable. Two brothers out hunting stray cattle, once penetrated through dense scrub to a cañon's edge. There, in the opposite cliff before their astonished eyes, lay a whole city. The dry air had preserved it well through the thousands of years

What remains of the large village of Puye, in the Frijoles Canon, in New Mexico. This is one of the most interesting and picturesquely located of the many prehistoric ruins on the Mesa (plateau). The small holes supported timbers used for porches. The region roundabout abounds in curios

Making Isinglass from the Swimming Bladder Used to Clarify Wine and Beer, to Make China



Photos by Bureau of Fisheries

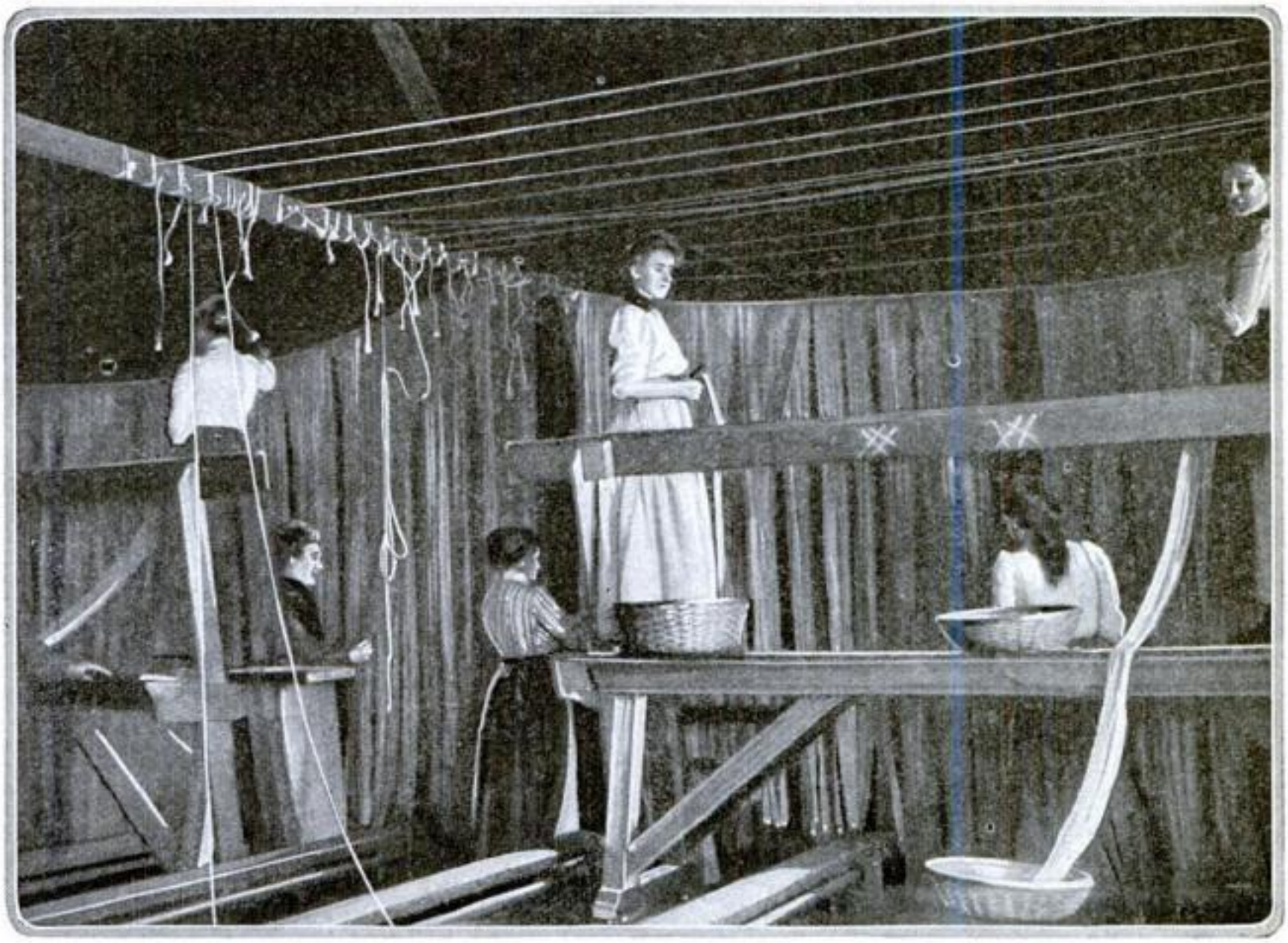
Drying the Bladders

Sounds from hake being dried before they are converted into isinglass. The sounds are the swimming bladders of the fish. They regulate its weight so that it can maintain its position at whatever water level it chooses. One ton of hake will yield from 300 to 500 sounds weighing from 40 to 50 pounds.

From Bladder to Isinglass

Rolling hake sounds for isinglass. The dried sounds are softened by soaking them in water. They are then cut into small pieces. The material is mixed again and run between iron rollers. It is then passed through hollow, water-cooled rollers and comes out in sheets. Finally the sheets are passed through small ribbon rollers.

of Fishes. This Product of the Hake Is Cement and to Provide Court-Plaster Adhesive



Ribbons of Isinglass

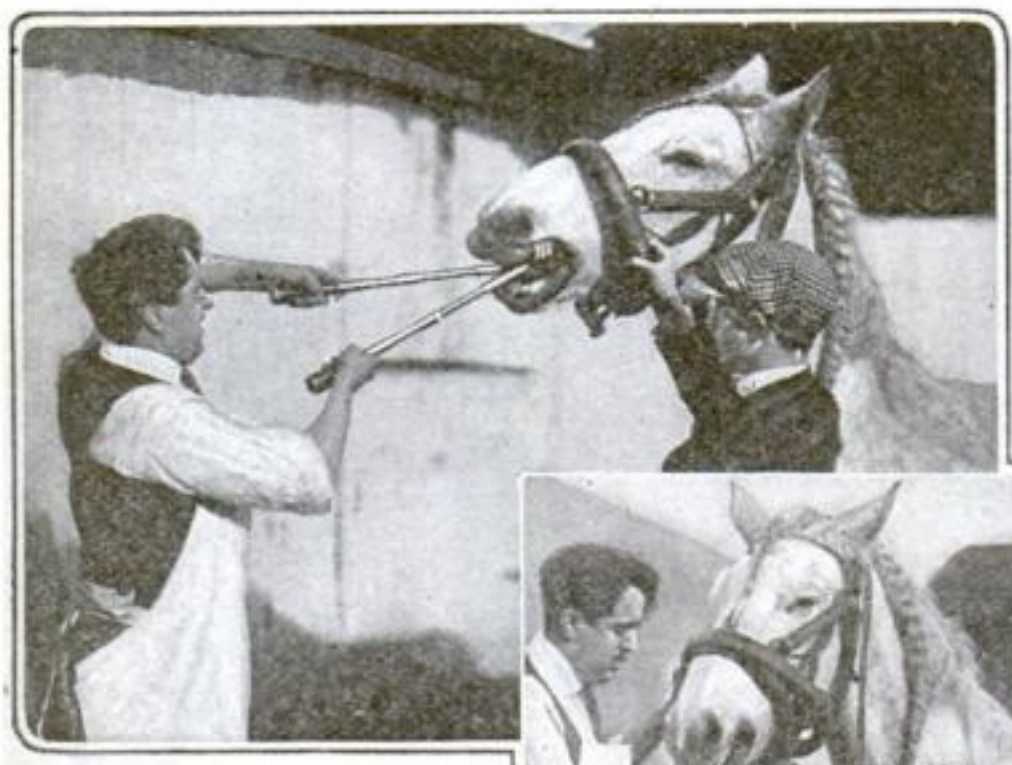
This is not a picture of spring housecleaning. It is the drying room of an isinglass factory. The ribbons are dried in a few hours by being hung in a moderately warm, light room. The ribbons are carried in baskets into the drying room where they are hung up by women. When dry they are wound into coils weighing less than a pound. One fifth of the original weight of the sounds is lost during the complicated process of turning them into commercial isinglass.

Uses of Isinglass

Winding the dried ribbon isinglass on a wooden spool. One ounce of isinglass will clarify 200 to 500 gallons of wine and one pound will clarify 100 to 500 barrels of beer. It is also used for making cement for repairing glass and pottery, for the adhesive in court-plaster and as a dressing for textiles, which imparts luster and stiffness to linens and silks. In combination with other substances it is used to make india ink and to waterproof fabrics.

Taking Old Dobbin to the Dentist

Horse-dentistry is not one of the overcrowded professions. It is not a calling for weaklings



If a horse has lost a tooth in one jaw, the one opposite grows very long because nothing grinds it off. The dentist trims off long teeth with the nippers

Horses as a rule prove themselves docile. Here the operator is spraying out the horse's mouth in order to prevent the formation of cavities

PHILADELPHIA has a dental office for horses. You, or rather the horse in company with you, enter the office through a special doorway and are ushered into the waiting room. Here you may rest and improve your mind with the out-of-date literature usually found in dental establishments, while your equine friend is taken to an operating room in the back.

The operating department consists of a number of stalls, well padded and carpeted with hay, so that the horse runs no risk of injury should he rear during the investigation of his dental equipment. First, he is fastened securely by straps running from both sides of the stable to his head and also from the roof of the stall, so that he cannot move his head sideways or up and down. The straps are connected with a heavy rubber harness that slips loosely over the jaws of the horse.

Not being gifted with the power of speech, the horse cannot tell the dentist which particular tooth is troublesome. It is therefore necessary for the dentist to locate the aching tooth for himself. This is not so difficult as it may seem. The dentist locates the troublesome tooth either by the presence of an abscess or, if there is none, by means of an implement called a "float." With the float, which is but a long-handled file, the dentist feels along the teeth until his sense of touch tells him he is in contact with a loose tooth. That is the tooth to be removed. Extraction is about the only remedy when a horse has the toothache. There is no such thing possible as filling a horse's decayed tooth.

The horse, suspicious and nervous as soon as he feels the gripping forceps, involuntarily helps the operation by flinging up his head. He almost pulls the tooth himself. The difficult part of the operation for the dentist is to hold the tooth firmly in the forceps and help with a counter pull. Most of the dental trouble of a horse occurs with the upper teeth so that it is seldom necessary to extract a lower one.

All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you.

How Floating Particles of Dust Cause a Fire

SPONTANEOUS combustion is caused, so the chemists tell us, by floating particles of coal dust or other inflammable material jostling and clashing against one another until the friction they set up raises their temperature to the ignition point. If this explanation is correct, it would appear as if such fires could be prevented by perfect ventilation. Such, however, is not the case, for ventilation may actually help to bring about fire by spontaneous combustion. Air facilitates oxidation, really fanning the warm dust into a blaze. Keep air damp and quiet to avoid fire.

The palace was constructed of ice blocks cut and laid like blocks of stone

The cannon were also made of ice and were strong enough to fire off charges of real gunpowder

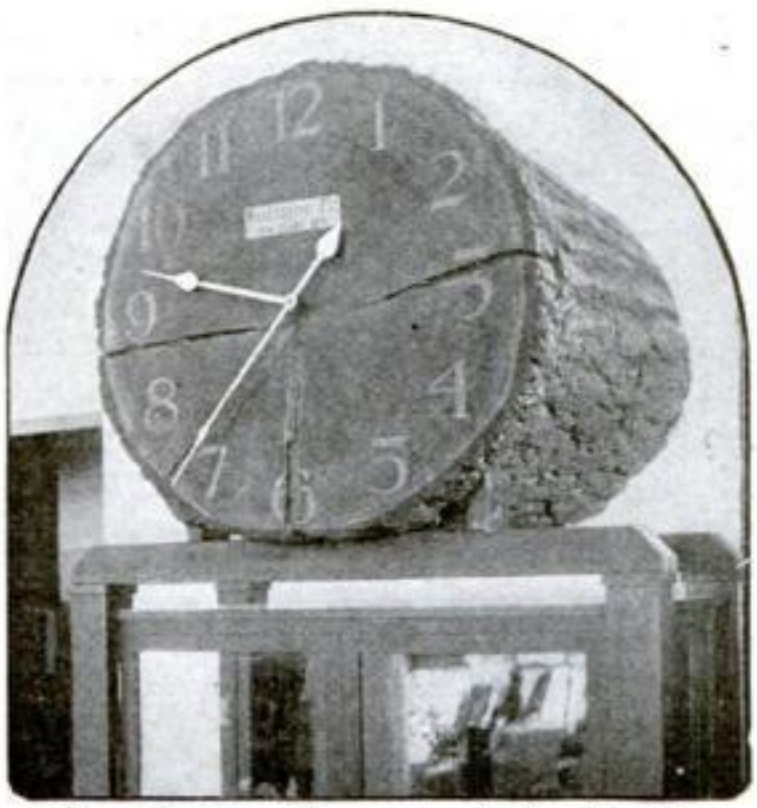
Guns of Ice That Fired Real Powder

MORE than one hundred and seventy-five years ago some ingenious Russian workmen conceived the idea of constructing a building of solid ice in the city of St. Petersburg, now Petrograd. They erected the structure shown in the accompanying illustration. It was fifty feet long, sixteen feet wide and twenty feet high. Before the palace, they placed six cannon of the six-pounder size, and these too were made entirely of ice. They were turned on a lathe. The cannon were more than ornaments. They could and did shoot actual charges of powder. Although the bore of the barrel was only four inches, the ice was sufficiently strong to withstand the force of an explosion of nearly two thousand grains of powder.

A Clock with Works Encased in a Huge Log

EVERYBODY stops to look at a clock in the offices of the Manufacturer's Association, in Seattle. It is a curious time-piece, the works of which are encased in a hollowed section of a Douglas fir log, probably more than two hundred and twenty-five years old. The section of the log serves admirably as a dial for the clock, the numerals, showing plainly

The appearance of the clock is not its only claim to distinction. Its size also warrants more than ordinary interest. The dial of the clock is more than three and one-half feet in diameter and the minute hand more than four feet in length.



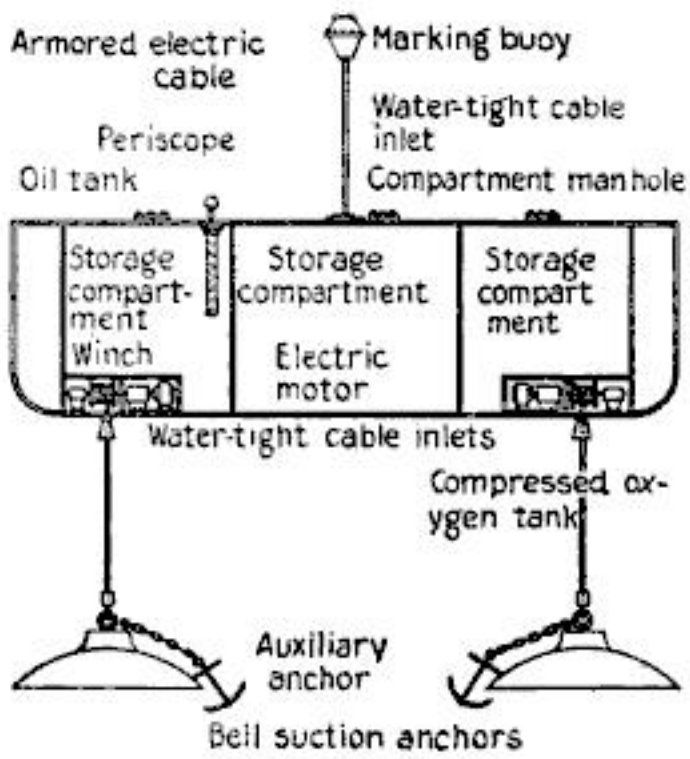
The clock works are contained in the hollowed section of a fir log more than two hundred and twenty-five years old

Supplying Submarines by Trailer

Carrying fuel and supplies in a tender, a submarine is made lighter and more mobile

AUTOMOBILES have trailers, motor trucks have trailers—why not submarines? Apparently acting on such an idea, Philippo L. E. del Fungo-Giera, of New York city, has patented a tender or trailer which submarines may frisk over the high seas as unconcernedly as a farmer hauls his milk cans in a two-wheeled vehicle behind his Ford.

The tender, which is about thirty feet long, can be submerged a convenient distance from the field of operation and thus concealed from the enemy. In it, fuel supplies, compressed oxygen, oil and other stores are carried. When the submarine runs out of such necessaries it can return to the tender and renew its store. The frequent long trips to and from a naval base are largely eliminated.



Cross-section of the tender, showing the storage compartments and apparatus used

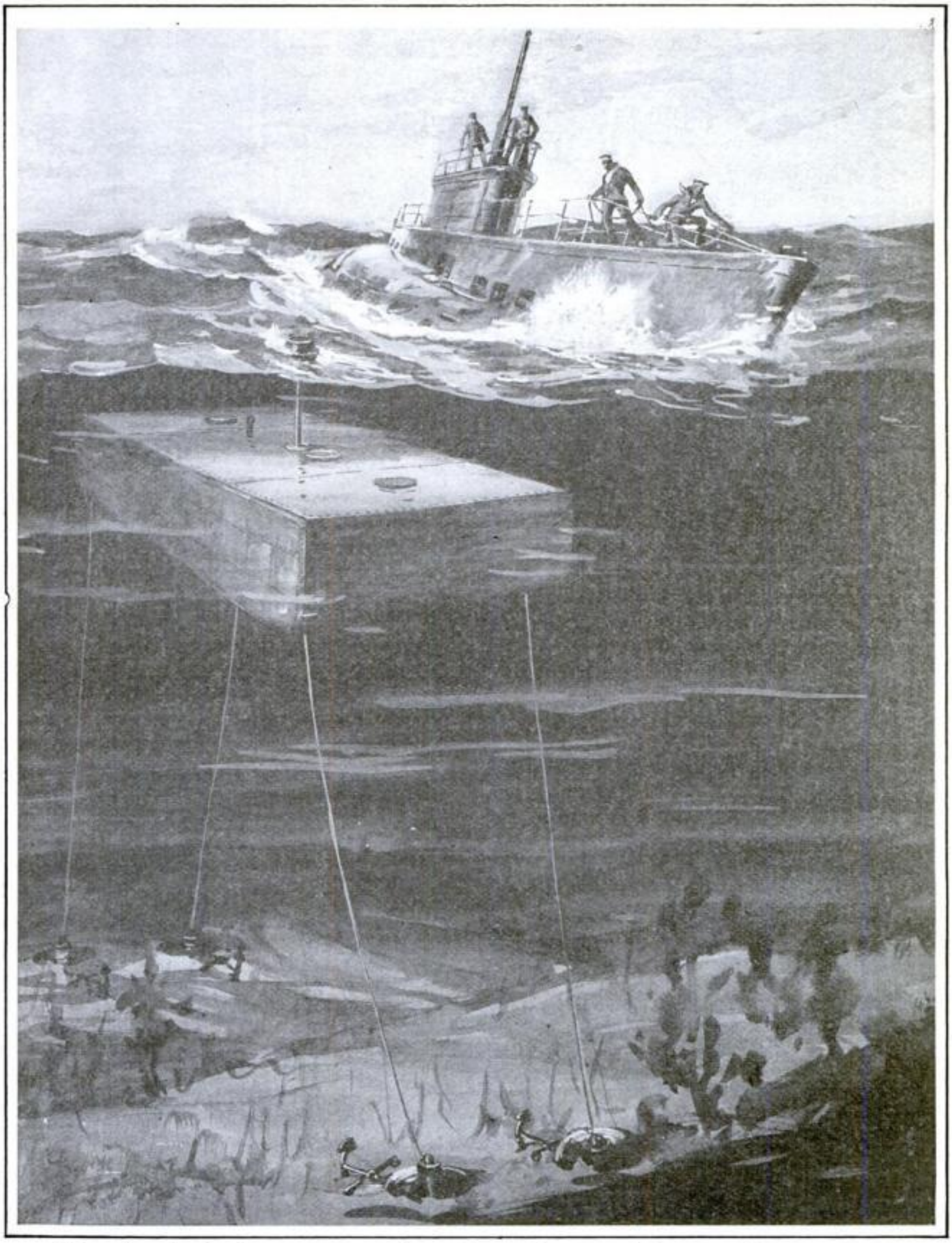
Of interest about an invention of this kind is the fact that while the Allies might use it, it is improbable that the Germans could. The North Sea is patrolled by several thousand submarine-chasers of various types for which reason it seems unlikely that the Germans could use the idea.

Upon approaching the scene of action the submarine vessel would attempt to reach shallow water if possible. There she would submerge and anchor the tender. For this purpose an armored cable connects the electrical machinery within the tender with the controlling mechanism inside a marking buoy above. The crew unbolt the cover of the buoy, insert an electric plug which is connected with the submarine's dynamos, and turn on the current. Four anchor cables are released instantly. Electric motors drive the four winches which partially wind up their respective cables again. The tender is thus made to sink to the desired depth, while the buoy cables automatically pay out a corresponding amount. After concealing the marking buoy with seaweed, observations are taken to determine its position, and the submarine proceeds upon its way.

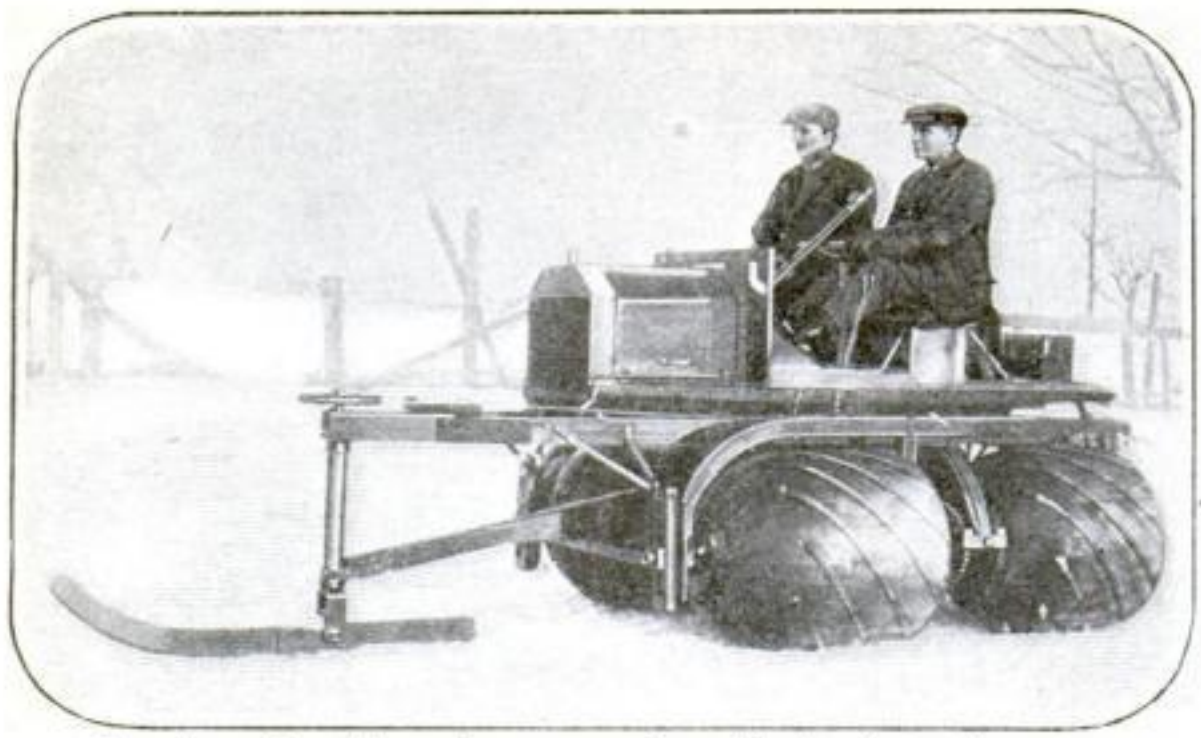
Allied submarines which operate in the Baltic sea, perhaps a thousand miles from their naval bases, ordinarily have to spend a week's time in traveling to the scene of action and returning. Fuel and provisions are used up so rapidly that the submarines have little more than a week and a half in which to raid Germany's ships. However, advocates of the new invention believe tenders are capable of improving this situation. While pulling a trailer may slow up a submarine's progress to and from bases somewhat, this is made up for by the longer time the store of supplies brought along permits the craft to stay at sea. It would clearly be out of the question to haul supply tanks through the North Sea, around the north of Scotland, and to plant them in the Atlantic Ocean itself.

Obtaining supplies from the tender is accomplished by first manipulating the anchor cables in such a way that the craft may rise to the surface. Then one of the crew opens and enters a manhole, afterward taking out through this opening any package stores the submarine may desire. The stored oxygen, which is used for breathing when the submarine travels under water, is discharged into the submarine by means of suitable hose connections. The oils are likewise pumped across through hose. A man may be left permanently on the tender to lower it still farther if in danger.

There's Food and Drink and Fuel in the Tank



The submarine is about to return to its tender to take on needed stores. The crew simply lassoes the floating buoy, connects an electric cable, and by means of a control mechanism inside the submarine, causes motors within the tender to unwind the anchor cables and allow them to come to the surface. A member of the crew then scrambles over to the tender, opens a hatch, and takes out any package stores desired. Oil and fuel are transferred by pumping them through a hose. The oxygen is also piped across. If desired, a man may be left on the trailer permanently, to raise or lower it by means of hand winches when necessary



The four sheet-iron drums revolve sidewise but the auto sled goes forward. The long runner in front is for steering

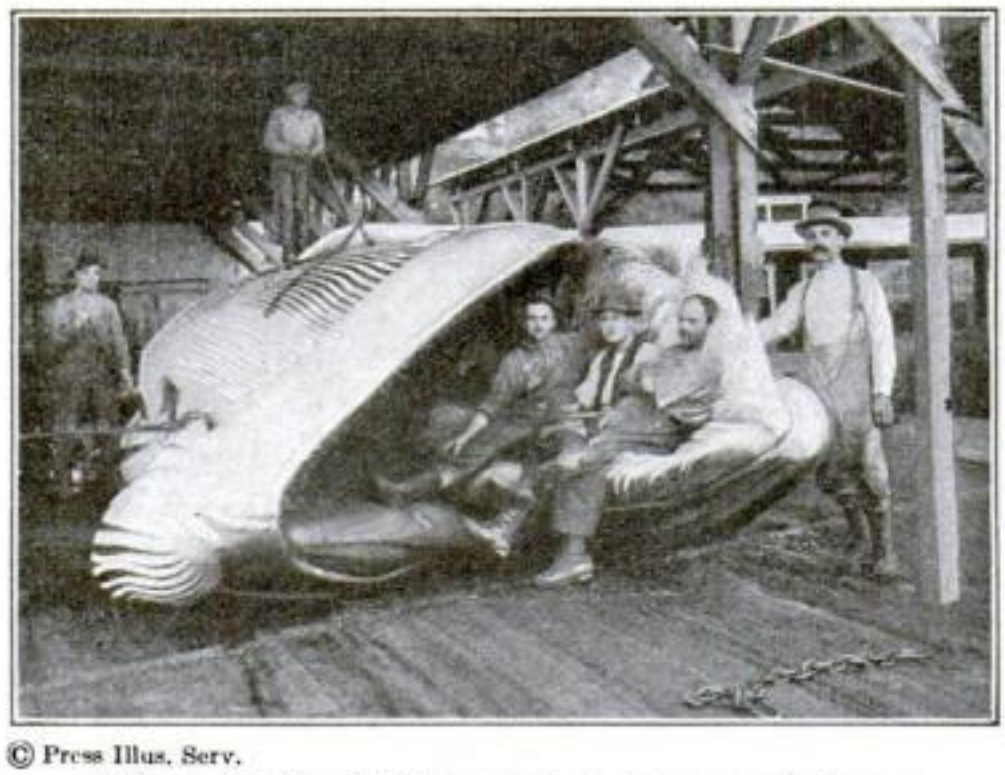
Skating Over Ice and Snow in a Queer Motor Sled

MOTOR sleighs have not yet been perfected, although there is a genuine demand for them in northern countries. It is difficult to get traction on rough ice or in loose and deep snow. But sideslip of the vehicle is the most obstinate source of trouble, and the control on hills, whether going up or down, is precarious. Safe steering depends greatly on the driver's sharp eye and caution. For a tractor intended to haul loads over ice and snow, these difficulties are much aggravated, unless the speed can be very low; yet such a tractor has been invented and built by Frederick K. Burch, of Grand Rapids, Mich.

Clumsy as it looks, a speed of thirty miles per hour is claimed for this vehicle when it is let loose on a level stretch of ice. In the photograph, the motor equipment is recognized as that of an old Ford. By means of chains mounted crosswise under the middle, four sheet-iron drums, which also support the vehicle, are rotated: those on the right side to the left (seen from above) and the pair on the left side to the right, as if meant to scrape the road from under the middle to both sides. The drums are rounded in front to rise easily over rough spots and to facilitate steering. They carry curved (helical) channel-iron ribs which grip the ground against sideslip as well as for traction. This driving principle was tried on a motor sleigh at Chamonix, near Geneva, Switzerland, several years ago, but with only two relatively small ribbed drums held against the ground by springs, as the main load was supported on runners.

A Whale Which Strains Its Food Through Whiskers

ALL whales develop rudimentary teeth before birth. If the teeth continue to grow, the whale is put in the toothed class; if the teeth are displaced by a large number of flattened plates of bone or baleen, fringed at the edges, the whale is put in the whalebone class. Baleen forms a sieve through which the whale strains all food collected from the water. The three men shown in the illustration are reclining in the whale's mouth, directly against the baleen, which looks like a polar bear's skin. It is anything but that, for what seems to be hair is really shredded bone.



© Press Illus. Serv.

The whale's whiskers are a horny substance used as a sieve through which food is strained

The Steel-Plated, Helmeted Knight of the Trenches

BACK in the Middle Ages the doughty warriors went to battle fully armored. In times of impending danger, the knight's squire must have spent about a half day getting his master into his trappings.

Beside the exhibit of ancient armor stands a modern British Tommy. He too, is steel-plated. And thus does progress move in circles. For armor is coming back into use again.

At all times the wearing of armor is limited by three principal conditions; the weight of the type available, the kind of weapons and ammunition in use by the enemy, and the degree of movement expected of a soldier. If the weight is too great, the soldier soon tires; if the enemy is using high-powered guns at close range, armor is of little use; and if a soldier must run about, steel appendages are in the way.

Steel helmet and chest-covering of the modern British soldier on left make him resemble knight in armor of old (right)

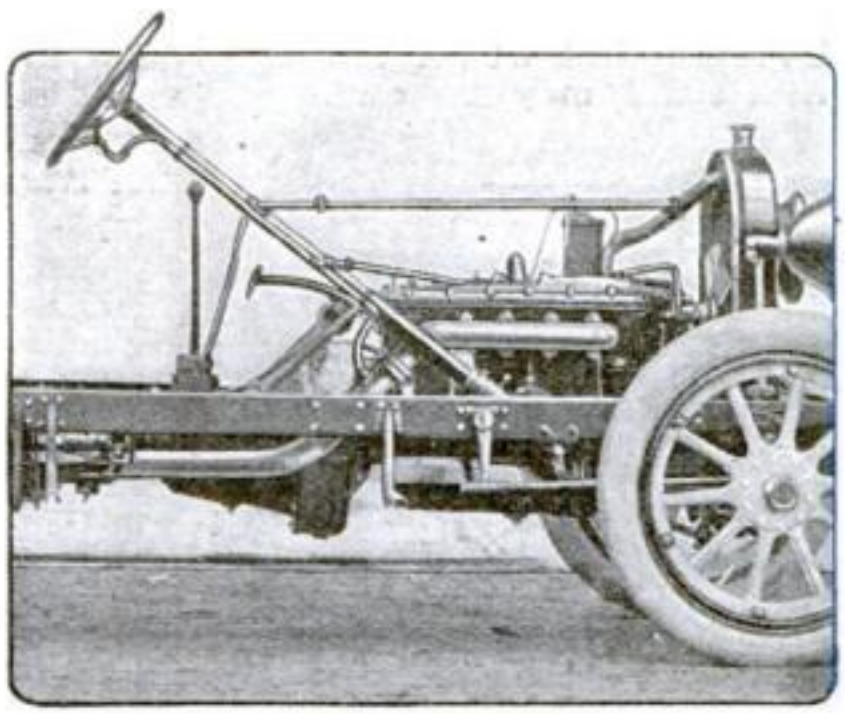
Use Your Hot Radiator Water to Keep Your Steering-Wheel Warm

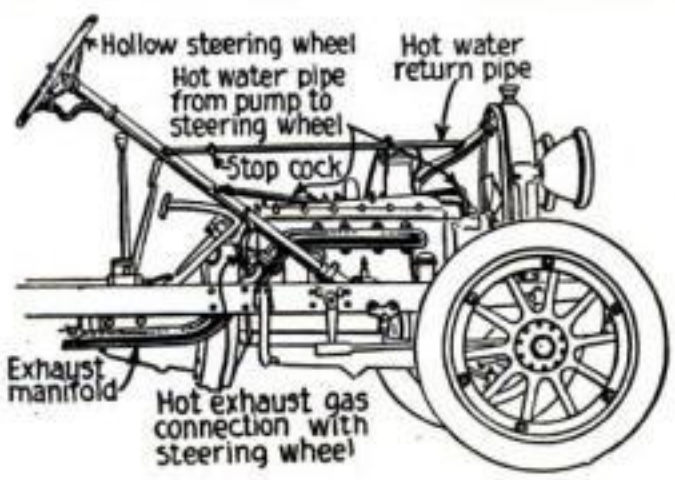
THE happy idea of utilizing the boiling water in the automobile radiator and the red-hot gases from the engine for keeping the driver's feet warm, has already been presented in the POPULAR SCIENCE MONTHLY.

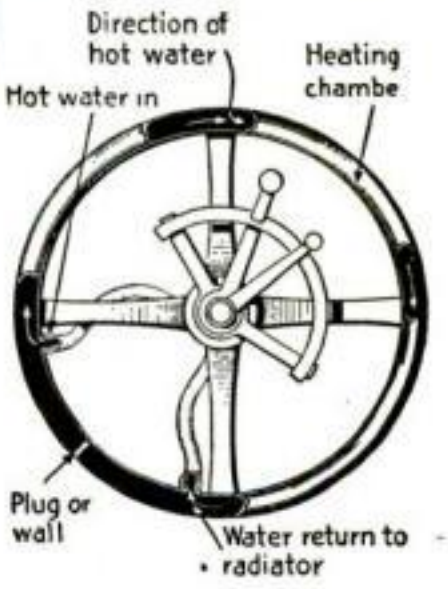
Charles C. Walker, of Utah, has now finished this job by devising an arrangement for similarly warming the chauffeur's hands.

The hollow interior of the steering wheel is connected across a part of the circulation system of the engine. By means of a pair of valves, the flow of the hot water can be regulated to give a delightful warmth. Hands were meant to be warm and radiator water to be cold. This idea benefits both ways.

If the water is too hot to be controlled easily, the exhaust engine gases can be used.

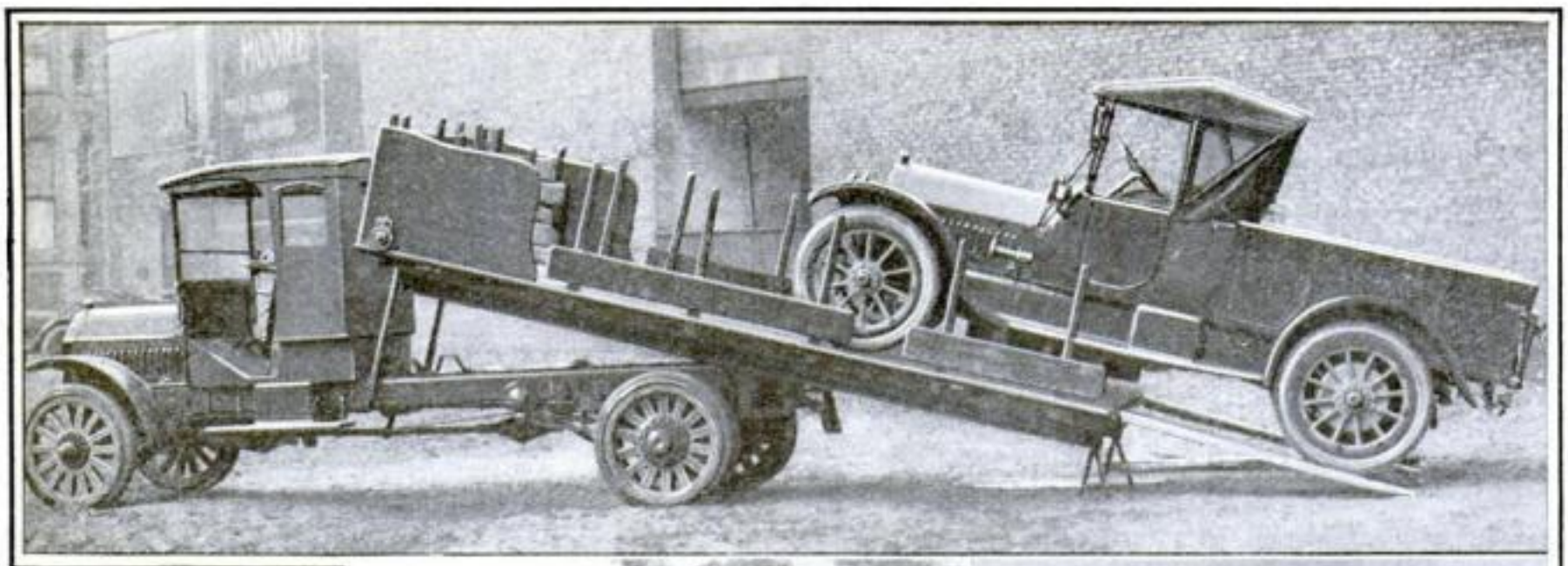






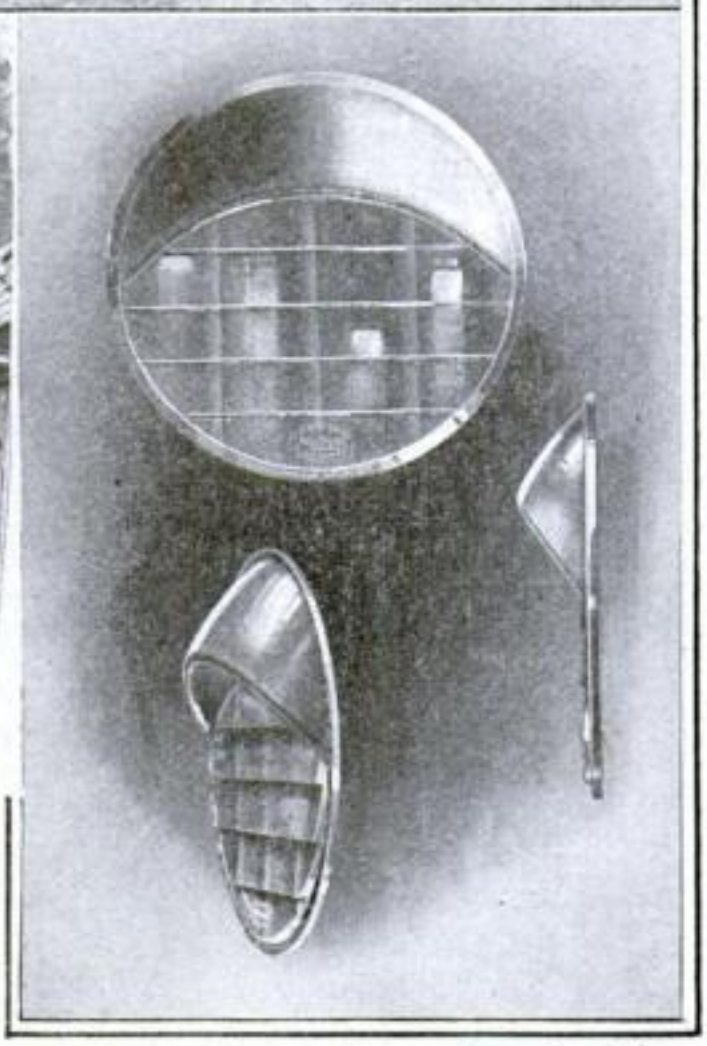
Warming the steering wheel with water from the radiator tank. At left is shown how the water and the exhaust gases can be utilized for this purpose. At right is shown the wheel arrangement by which the hot water circulates through the rims

Up-to-the-Minute Accessories for



To prevent the bodies of new automobiles from becoming scratched during transit the tipping truck body is now used

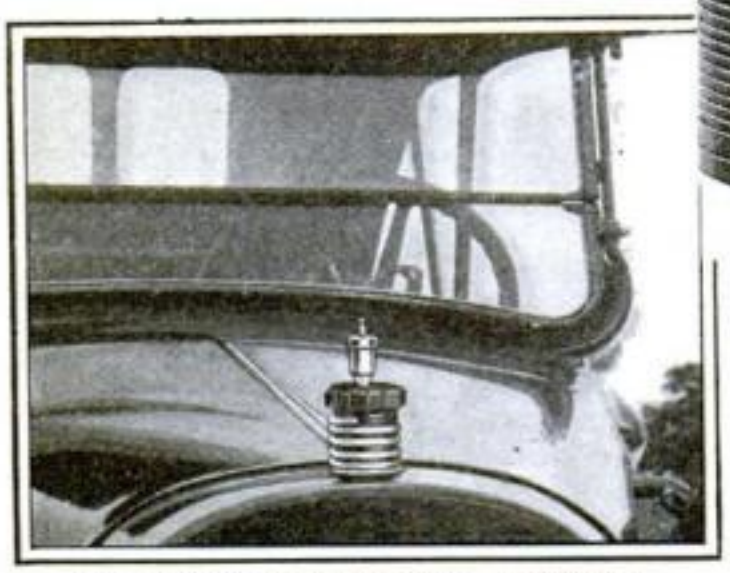
Cabinet or case for the automobile in which lunches, thermos bottles and other camp necessities may be carried



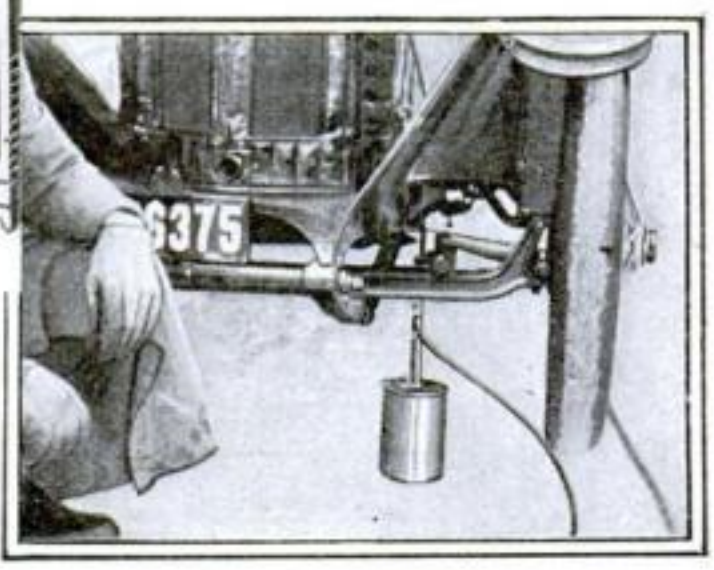
Lamp lens with a visor for directing the light rays downward and to the side through five horizontal prisms which deflect the light below the horizontal

A supplementary spark plug base in which the spark may be examined while the engine is running

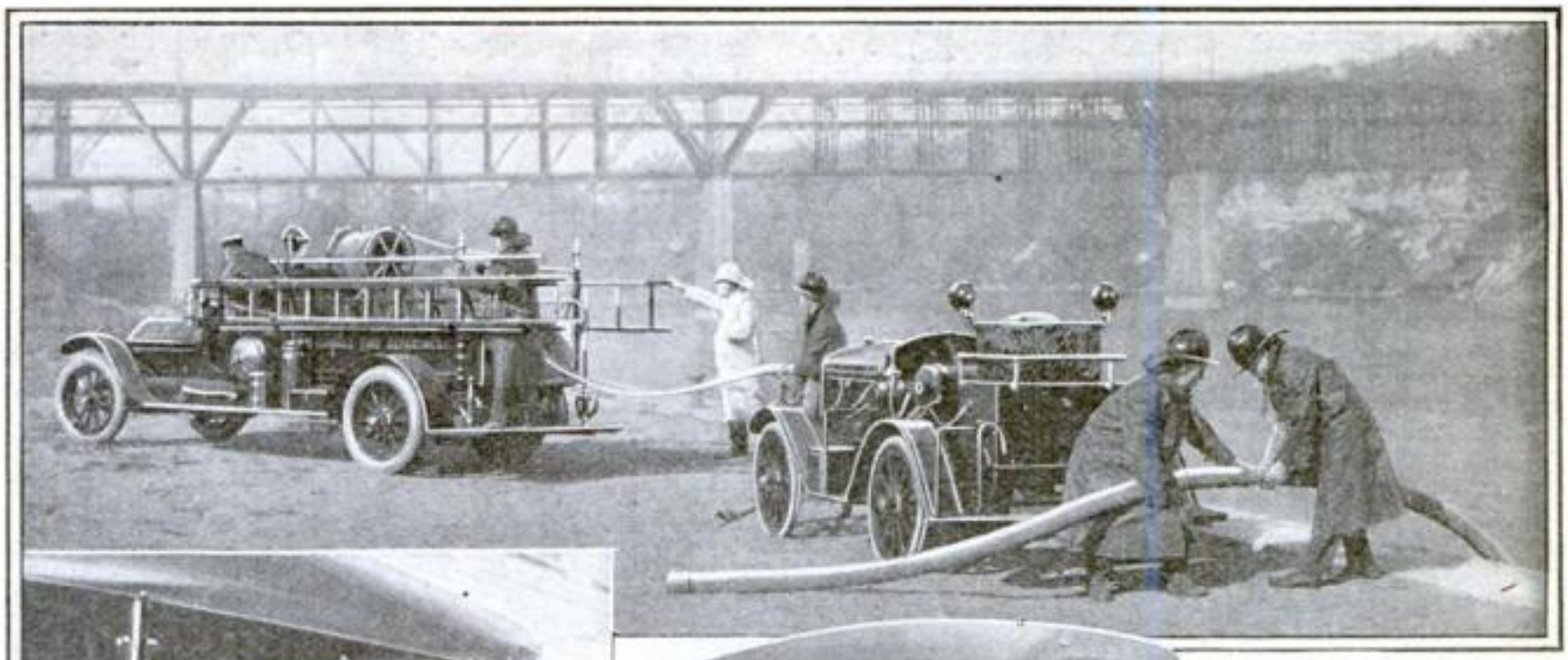
Piston ring that has room at the top for the expanding gases when the expansion compels the ring to fit snugly the walls of the cylinder



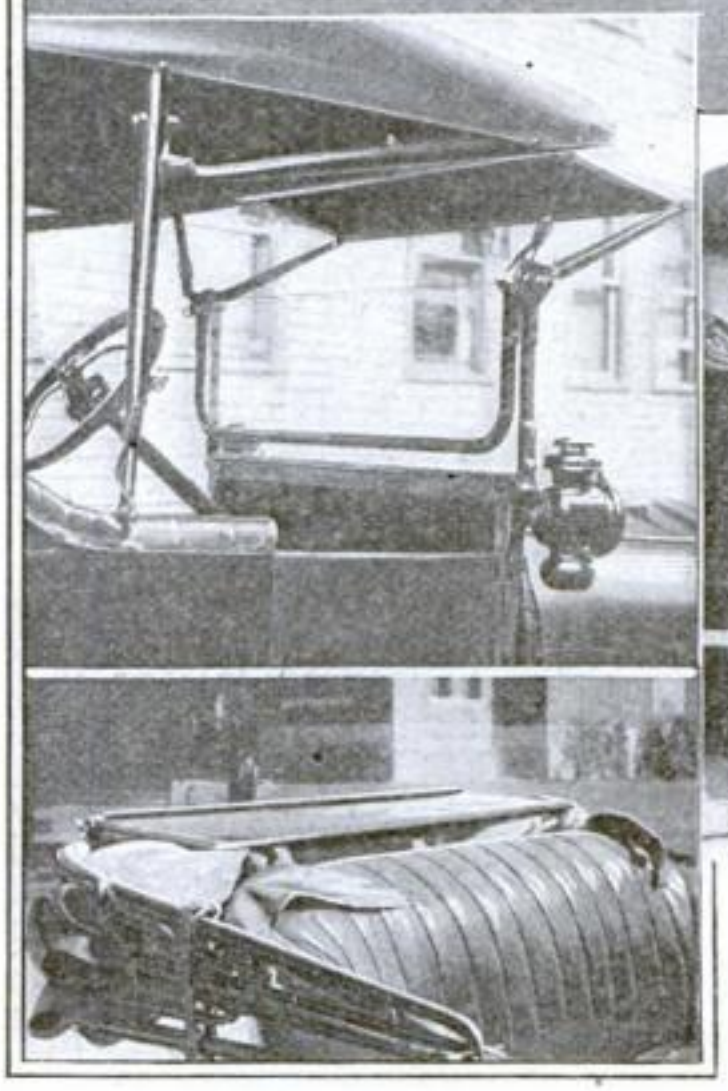
A miniature still on a radiator filler tube to catch and condense the alcohol vapors and return the liquid to the cooling water



Automobile jack worked by air pressure applied to a piston in a cylinder. The air hose is attached to the piston rod through which it is carried to the cylinder



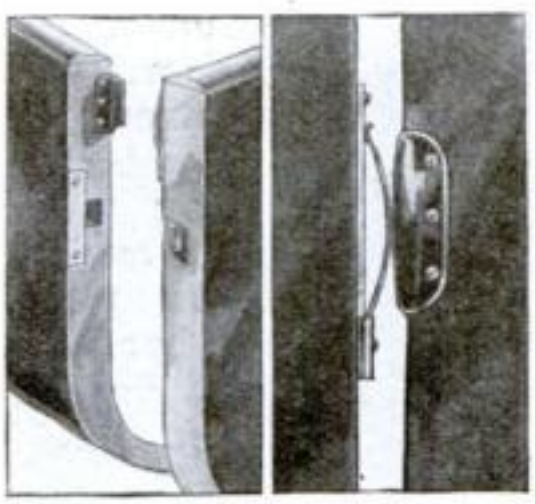
Gasoline engine-driven fire extinguishing appliance mounted on a trailer so that it may be drawn by a hook-and-ladder wagon or other equipment for fighting fire



Automobile visor which extends from the top and folds back with it. When in use, it keeps the rain and sun out of the driver's eyes

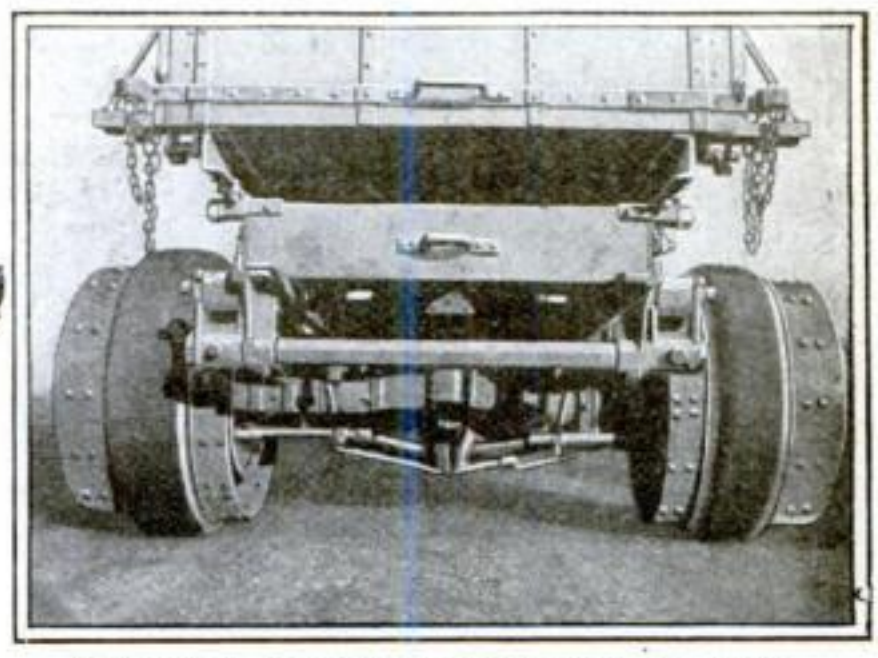
Short-handled mop similar to the ordinary household kind for washing the automobile. It has hose connections to run the cleaning water through the short, curved handle

Electric terminal threaded to engage spark plug center-bolt. One motion puts it on the plug or removes it when trouble impends



Rattling automobile doors are silenced by this stiff spring to hold the door tight against its jamb

Goggles that are easily attached to any hat rim or cap visor where they are supported. This lessens the unpleasant pressure on the nose

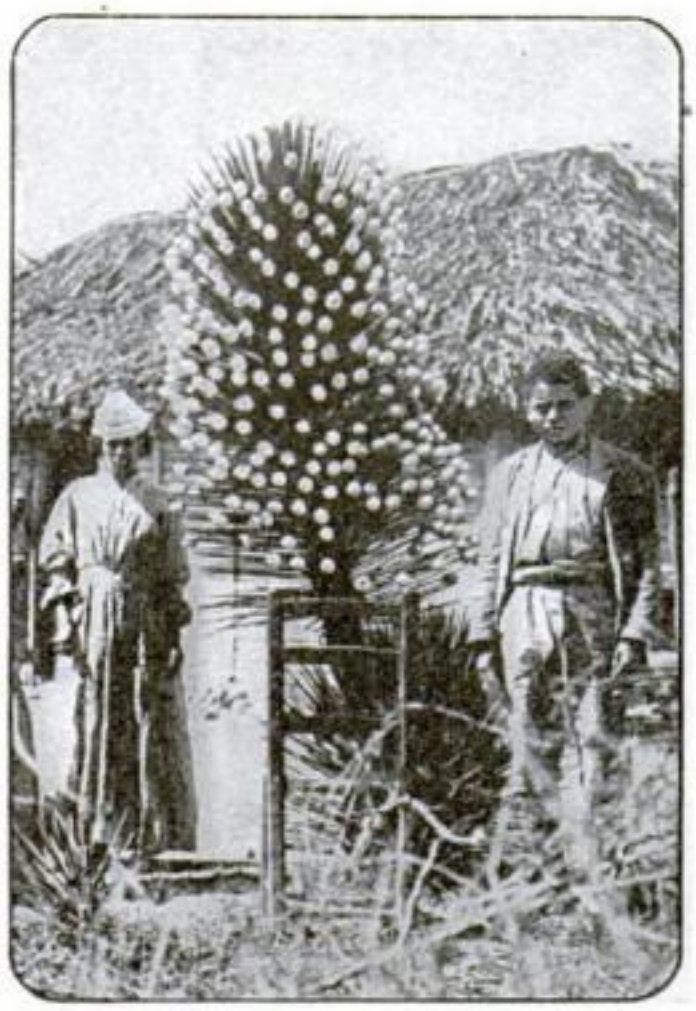


Extension rims for applying to the rear wheels of an auto truck when it is necessary to drive it through a soft place or on a muddy road where stalling is imminent

At Last the Breakfast Egg Has Broken Into Art

THE Nouveau Art movement has reached San Domingo.

There is a pine tree in front of the thatched domicile occupied by the dusky family immortalized in the accompanying photograph, but even its own mother would not recognize it now. In an effort to express their feeling for Art in its relation to Life, (observe that we use the customary capitals), these natives have decorated the pine needles with the shells of the eggs which they have eaten. The family seems thoroughly satisfied with the striking result.



No wonder there is an egg shortage. San Domingo natives use the shells for decorative purposes

Work the Brake—Quick! Or You'll Hit the Dummy

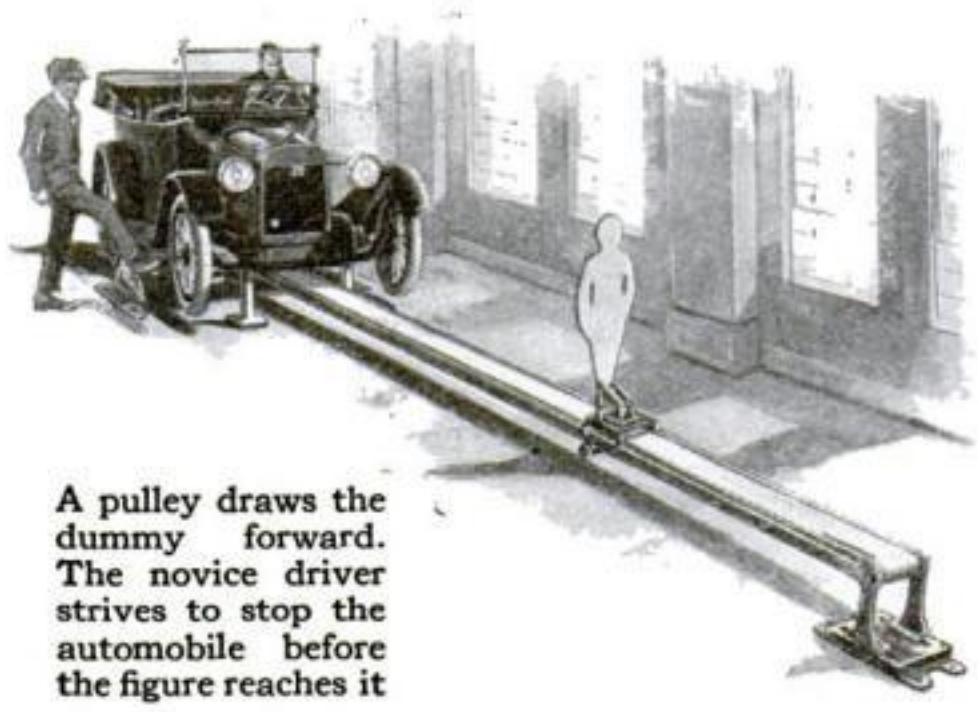
"APPLY your brakes, man, or you'll hit the dowager crossing the street." Remember when the automobile instructor shouted that command? And remember how you mistook the accelerator for the brake and shot past the fat lady at express train speed?

Such an experience was unnecessary. Study the accompanying picture and you'll be convinced. You could have substituted a dummy for the fat lady and with your automobile jacked up on all four wheels, you could safely have struck her amidships. The apparatus is the invention of John G. Torr, of Sydney, New South Wales, Australia.

In the car's jacked up position the front wheels may be turned at will and the rear wheels may be revolved by the power of the car engine just as if they were running over the road. A small transverse shaft underneath the rear end of the car is provided with a pulley over which the belt may run and with two friction drums which may be pushed into contact with the sides of the rear wheels to transmit the power and make the belt run. This is done by means of two small pedals, one on each end of the shaft.

One of these pedals is worked by the instructor so that the belt is set in motion toward the front of the car, carrying with it a life-sized figure of a man by means of a small stop on the belt. If the novice does not apply the brakes in time to prevent the figure from striking the car, by stopping the motion of the belt, the instructor may stop it by throwing the friction drums out of play by releasing the pedal.

If the skill of the novice is not sufficient to prevent the figure from striking the car, the figure is not broken but is simply folded down horizontally on the hinge on which it is mounted so that it can pass on under the car and travel back to the front of the conveyor, ready for the next trial of the novice driver's skill.

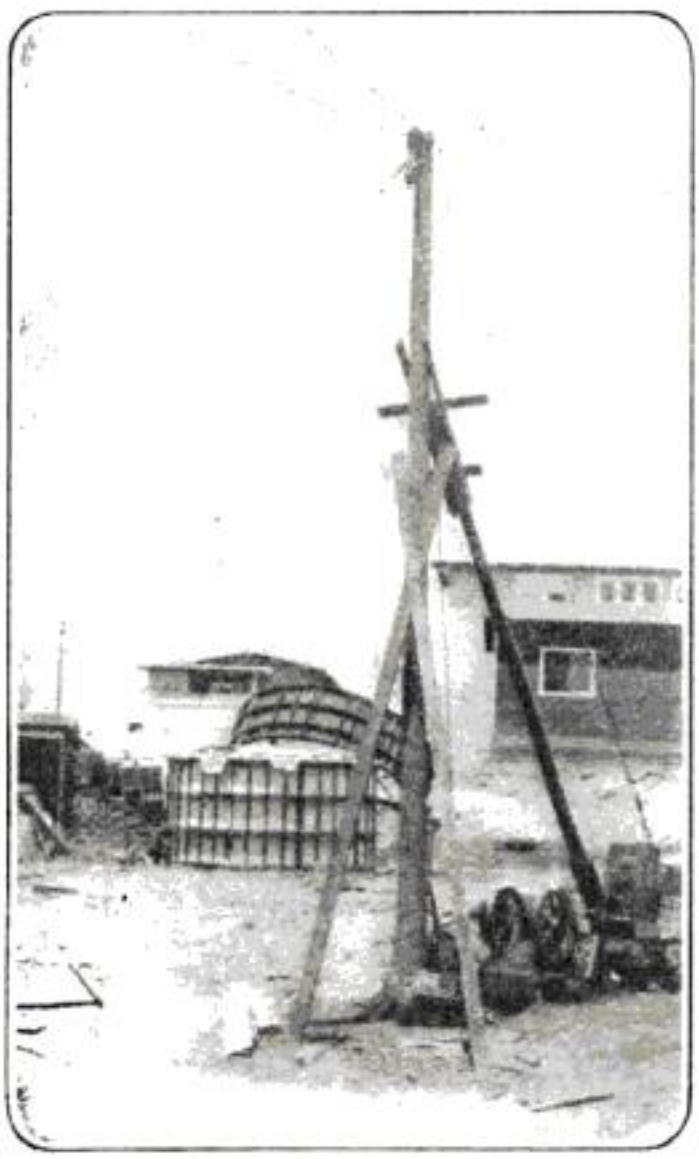


A pulley draws the dummy forward. The novice driver strives to stop the automobile before the figure reaches it

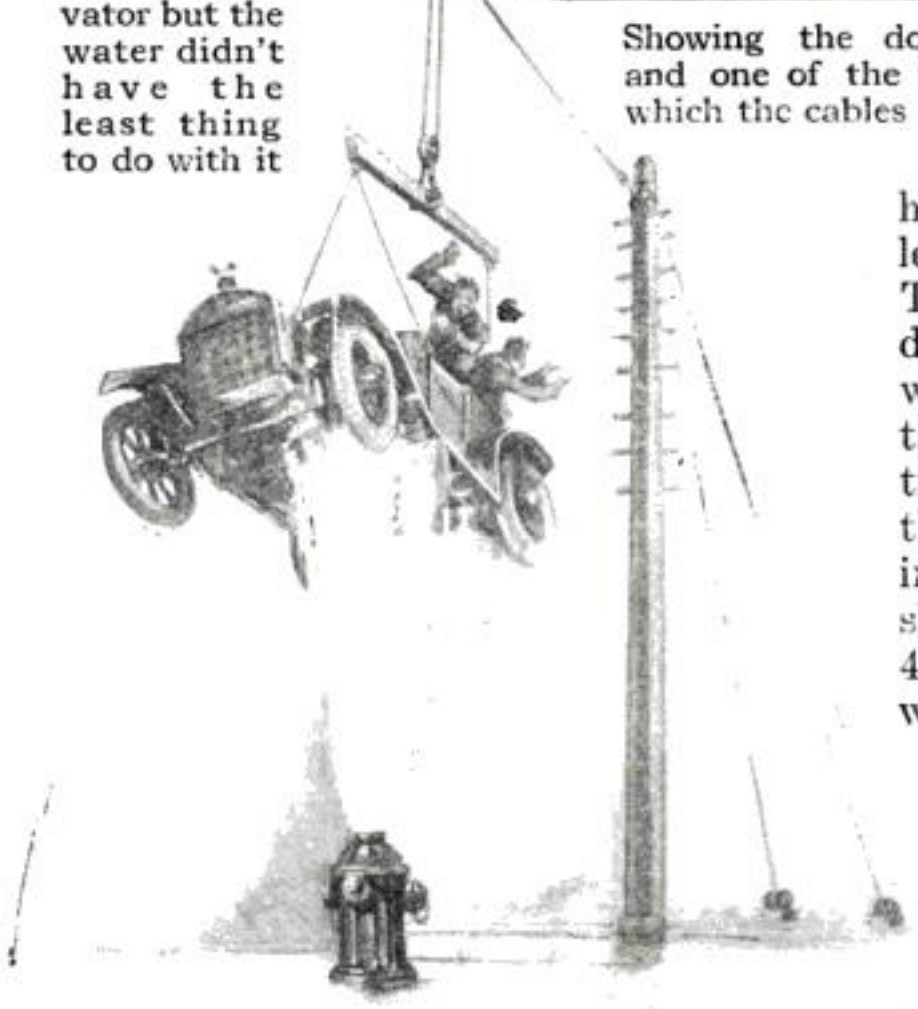
Forcing an Automobile Into the Air with a Stream of Water

IT was not until an automobile in Los Angeles ran into a hydrant, breaking it off and sending a column of water shooting up into the air, that some resident motion-picture directors thought of incorporating the idea in one of their thrillers. Had they known that in practically every shooting gallery in the country, one of the most popular targets is a ball suspended at the top of a stream of water, they might have staged the same thing years ago. But even though the idea was a bit old, it served their purpose.

With two poles, a donkey engine, cables, a hydrant and an automobile filled with actors, a stream of water was actually made to give the impression that it was holding up the car in the air. The car was attached to a crosspiece and it was hoisted up and down by the donkey engine. Water from the hydrant just touched the bottom of the car. Of course, the hoisting apparatus did not appear in the picture. All one saw was the frightened occupants in the car shooting up and down on the top of a powerful jet of water.



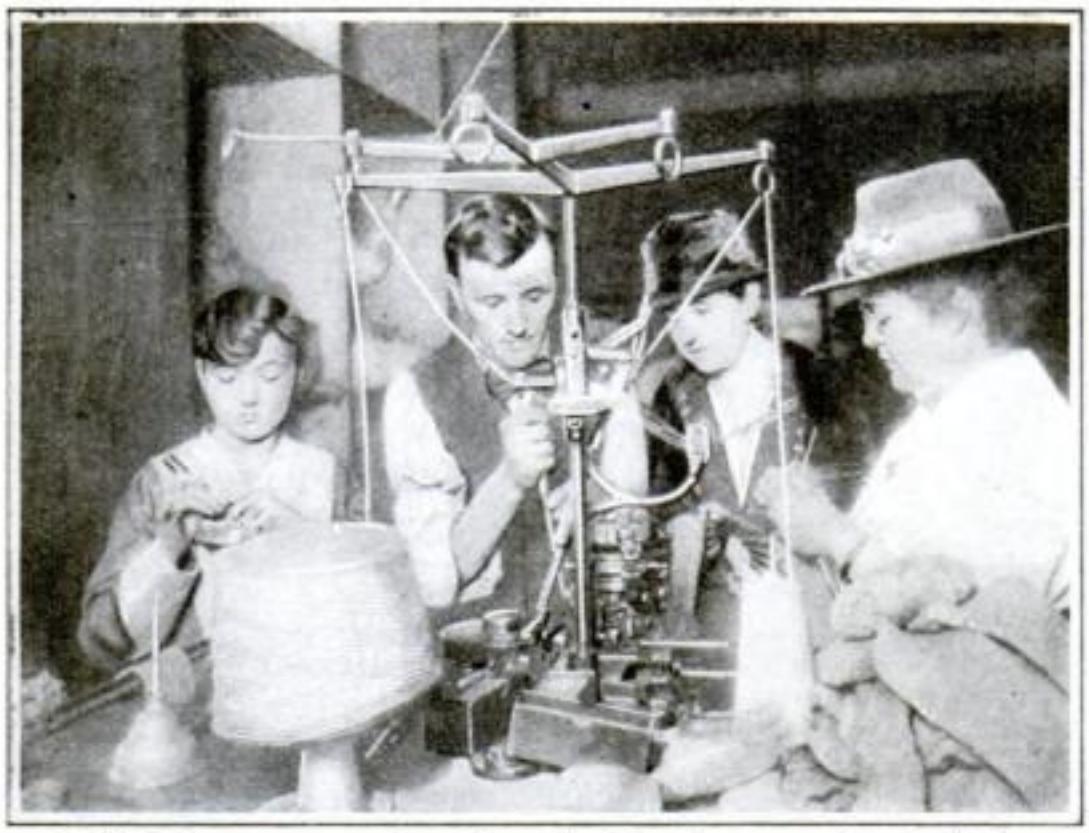
Showing the donkey engine, and one of the two poles to which the cables were attached



The automobile went up and down like an elevator but the water didn't have the least thing to do with it

Estimating Ship-to-Shore Distances

PROFESSOR J. JOLY, of Dublin, has suggested an ingenious method of measuring distances by wireless. He relies on the fact that disturbances travel with different speeds in different media. Sound travels eleven hundred feet or more a second in air and about forty-seven hundred feet a second in water, while wireless or light signals travel at equal speeds. Thus, if a shore station sends out these different signals at the same time, they will not be received by the ship simultaneously; there will be an interval of time between them that will increase as the distance of the ship from the shore increases. If a mile from the station, a ship would receive a sound signal in air 4.5 seconds later than a sound signal in water, and an air sound 5.5 seconds, or a sound in water 1.2 seconds, later than a wireless signal. Therefore, with a knowledge of the interval which elapses between the reception of any two of these different signals, it is a comparatively simple matter to calculate the source from which they have been sent. Knowledge of arithmetic is all that is necessary.



Faithful women workers learning how to operate a knitting machine which turns out ninety-six pairs of socks daily

Knit, and Let the Red Cross Machine Knit Too

EVEN with the women knitting on every permissible occasion, as well as on many unpermissible ones, the supply of knitted articles for the soldiers already in France and the many thousands in the large cantonments never equals the demand. Socks are especially needed. But, even if the click of knitting needles invades our dreams, and during our waking hours disturbs us at the theater or even at church, the average woman worker, be she ever so assiduous, can produce only one sock a day.

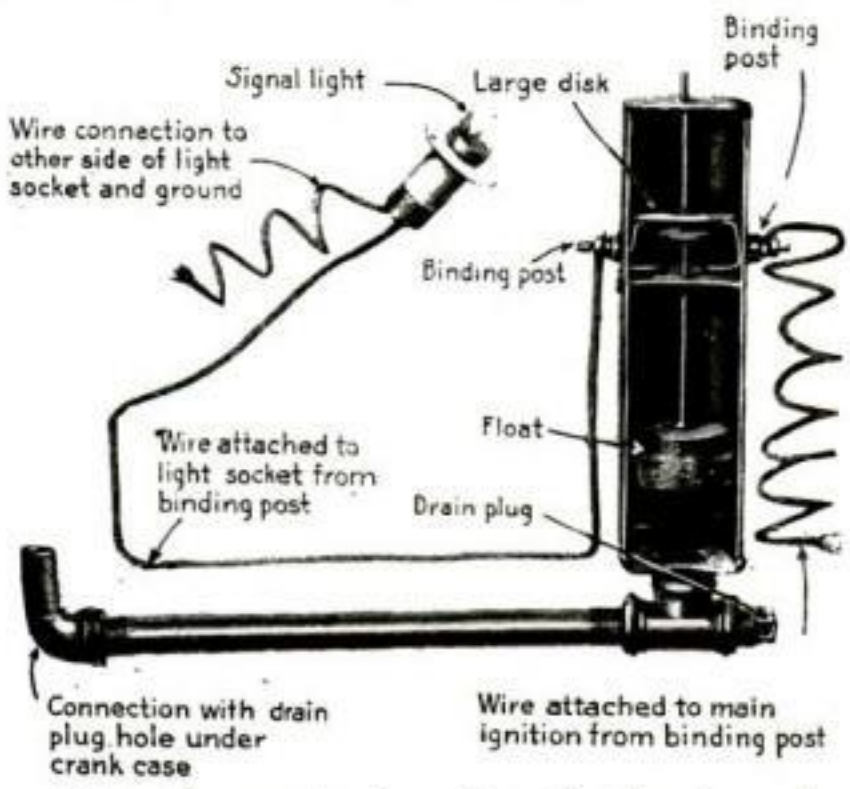
To meet the demand which the hand knitters are unable to supply, the Cincinnati Red Cross has had the first mechanical Red Cross knitter set up in its workroom. This machine turns out one hundred and ninety-two socks, or ninety-six pairs, in an eight hour day. In spite of its complicated appearance, it is comparatively simple to operate and it never drops a stitch.

No Oil? Your Car Will Stop Automatically

IF the engine of an automobile is not properly lubricated, the piston will in mechanical parlance "seize" the cylinder walls. The interior of an engine cylinder is highly polished, and so is the piston that fits within it. Between the piston and the cylinder wall is a clear space of about three-one-thousandths of an inch, which is about the thickness of the paper on which the POPULAR SCIENCE MONTHLY is printed. This minute space is filled with a film of oil. If that film should be destroyed, the piston would become locked to the wall, and an expensive repair bill would show the extent of the damage.

H. M. Dickerson, an automobile mechanic of Evansville, Ind., has invented an automatic device which keeps a check on the oil supply and takes the place of a faulty memory. The driver may be careless and negligent—but not Dickerson's automatic gage.

Within the gage is a float connected by a rod with a small disk above which is a large disk. As the float rises and falls the large and small disks rise and fall with the float. As the oil is consumed, the float descends. When the danger point is reached, the large disk touches the first of two sets of electrical contacts. A warning signal light flashes up on the dash; the driver is told that the oil is low. If the supply is not replenished, the float descends still further. The small disk then touches with the second set of contacts and the engine is automatically stopped before trouble results.

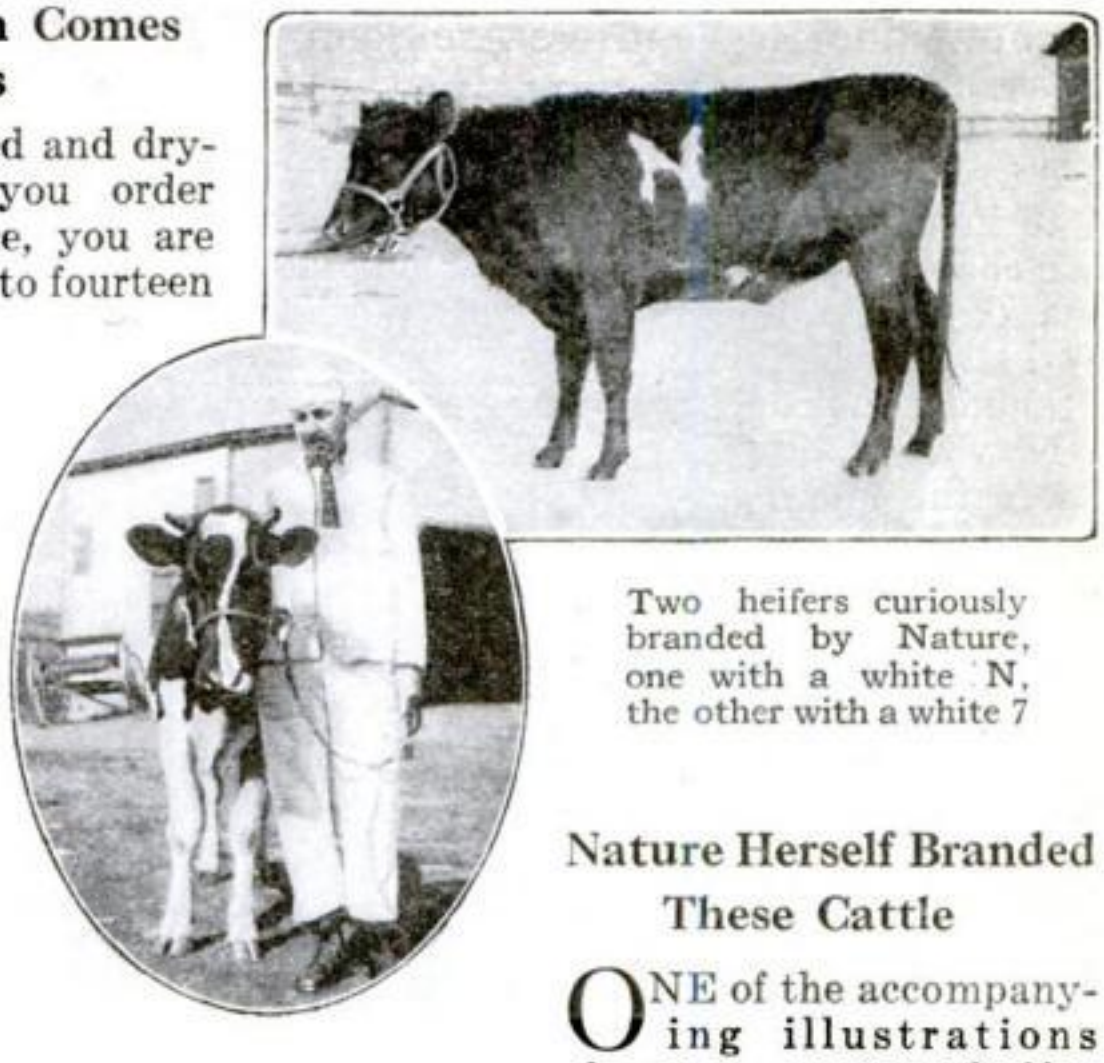


How the engine is automatically stopped when the oil supply becomes too low

Beware of Poultry Which Comes Packed in Barrels

INSIST on buying dry-packed and dry-chilled poultry. When you order poultry which is packed in ice, you are probably paying for from three to fourteen per cent. of water which has been soaked up by the bird. So states a report issued by the Department of Agriculture. This water ruins the flavor and the quality of the meat.

If possible, see the package in which your butcher receives the chickens. High-grade, dry-packed birds are commonly sent to market by the dozen in paper-lined boxes. Wet-packed chickens are shipped in large barrels.



Two heifers curiously branded by Nature, one with a white N, the other with a white 7

Nature Herself Branded These Cattle

ONE of the accompanying illustrations shows a young heifer owned by Henry Nelson, of Hicksville, O., which bears the letter N on its side. This letter was not burned in, nor has it any resemblance to the scarred brand. The hairs are white against the reddish back of the animal. Just what caused them to grow in such a way as to form the owner's initial is a secret which Nature has kept. Mr. Nelson would like to know so that he could use the style of branding on his other cattle.

The other illustration shows a large white figure 7 on the face of the seventh daughter of a seventh daughter, which is believed to have special significance. Possibly the animal will yield seven quarts of milk at a time and will usher in a period when milk will be seven cents a quart. Or perhaps the 7 has to do with the year 1917. You solve it. We give up.

Tent Stoves to Keep Our Soldier Boys Warm in the Training Camps

NO mental pictures this year of our soldiers freezing in their camps. They are made as comfortable as possible, although the stove with which the government provides each tent is not exactly like the big brick fireplace or the ornamental steam radiator at home. It is made of tin, with a jointed pipe to let cut the smoke through an opening in the top of the tent.

As the majority of the camps have purposely been located in sections of the country where the winters are mild, this heating device should prove adequate.

Burning wood as it does, fuel may be had at any groves or wood lots which happen to be near the soldiers' camps.

© Press Illus. Serv.

In our training camps, each tent is provided with one of these tin stoves which burns wood and brush

A Fowl and its Feathers Are Soon Parted—With This Machine

IT was O. G. Rieske's wife who led him to invent a mechanical chicken picker. She chased him out of their Buffalo home one day for attempting to pick a wild fowl all over her nice, clean kitchen floor!

Now O. G. can pick his feathered properties in peace and security. For the machine he has invented leaves an ordinary fowl absolutely naked in less than five minutes. Moreover no feathers are scattered.

A small electric motor turns a suction fan, and also a roller contained within the instrument itself, the power being transmitted by means of a flexible cable. The roller is hollow and its outer surface is pierced by a number of slits which permit the incoming blast produced by the fan to pass freely through it. The top of the instrument is hooded and attached to this hood is a little rubber roller which rests firmly against the surface of the larger drum-like wheel. The feathers of the fowl, sucked up against the two rollers, are plucked by having to squeeze between the rollers, after which they are blown to a tank. A thumb contact permits the hood to be moved around on its axis, and thus the relative positions of the two rollers are adjusted according to the needs of each case. The smallest wild fowl or the biggest turkey may be plucked with equal ease. A fowl can readily be picked in the dry state, but ordinarily it is scalded. This device is very useful in hotels and restaurants.

An electric motor furnishes the power by which the fowl is picked

Riding a Moose in the Waters of Rainy Lake

ON Rainy Lake, Ontario, the center of a virgin land where game abounds at all seasons, moose frequently swim across the arm of the lake.

After watching their chance and timing the chase when one of the animals was about the middle of the lake, some hunters cut it off by striking directly across from a point.

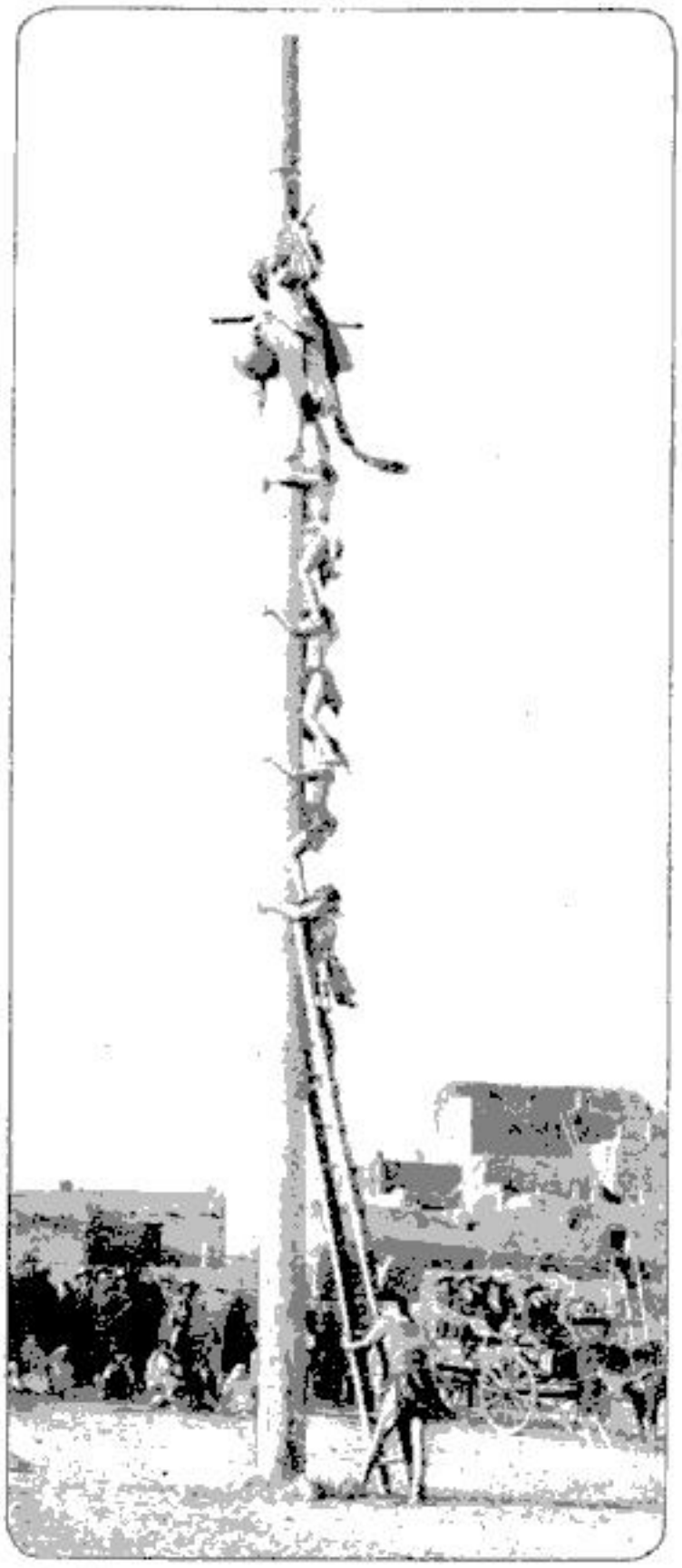
Paddling very fast in their canoe, they came alongside the animal and the man in the bow of the boat let himself from the canoe onto the animal's back. This in itself is a very difficult feat, as any one who has ever handled a tricky canoe can testify. Balancing himself on the animal's back, he suddenly let go and threw himself forward, maintaining his precarious position by grasping two of the points of the strong branching antlers. Thus he performed the very unusual exploit of making the lordly moose ignominiously carry his would-be slayer to shore.

This hunter performed the feat of jumping from the bow of the canoe on to the moose's back in mid-stream

How the Pueblo Indians Celebrate Their Thanksgiving

EACH year the Pueblo Indians who inhabit the two terraced, clay community houses which rise tier on tier to the height of five stories at Taos, New Mexico, celebrate the festival of San Geronimo Day. In the morning, races and dances are held; and in the afternoon, Indian clowns climb a thick pole, at the top of which hangs a dead sheep, vegetables and other food. The one fortunate enough to reach the top lowers the provisions to his companions, as the accompanying illustration shows. To climb this pole at all requires true Indian agility.

This Autumn festival is not so much a tribute to San Geronimo as a thanksgiving to the bountiful sun-god for the harvest that has been plentifully supplied. A great many tourists visit Taos and attend the picturesque ceremonies, which are held on the last day of September. There is not sufficient room to shelter them in the primitive little town, so they have to travel to the adjacent town of San Fernandez de Taos, two and a half miles distant. Here the canny Mexican population stages a celebration all its own, to extract from the travelers what loose coins they have.



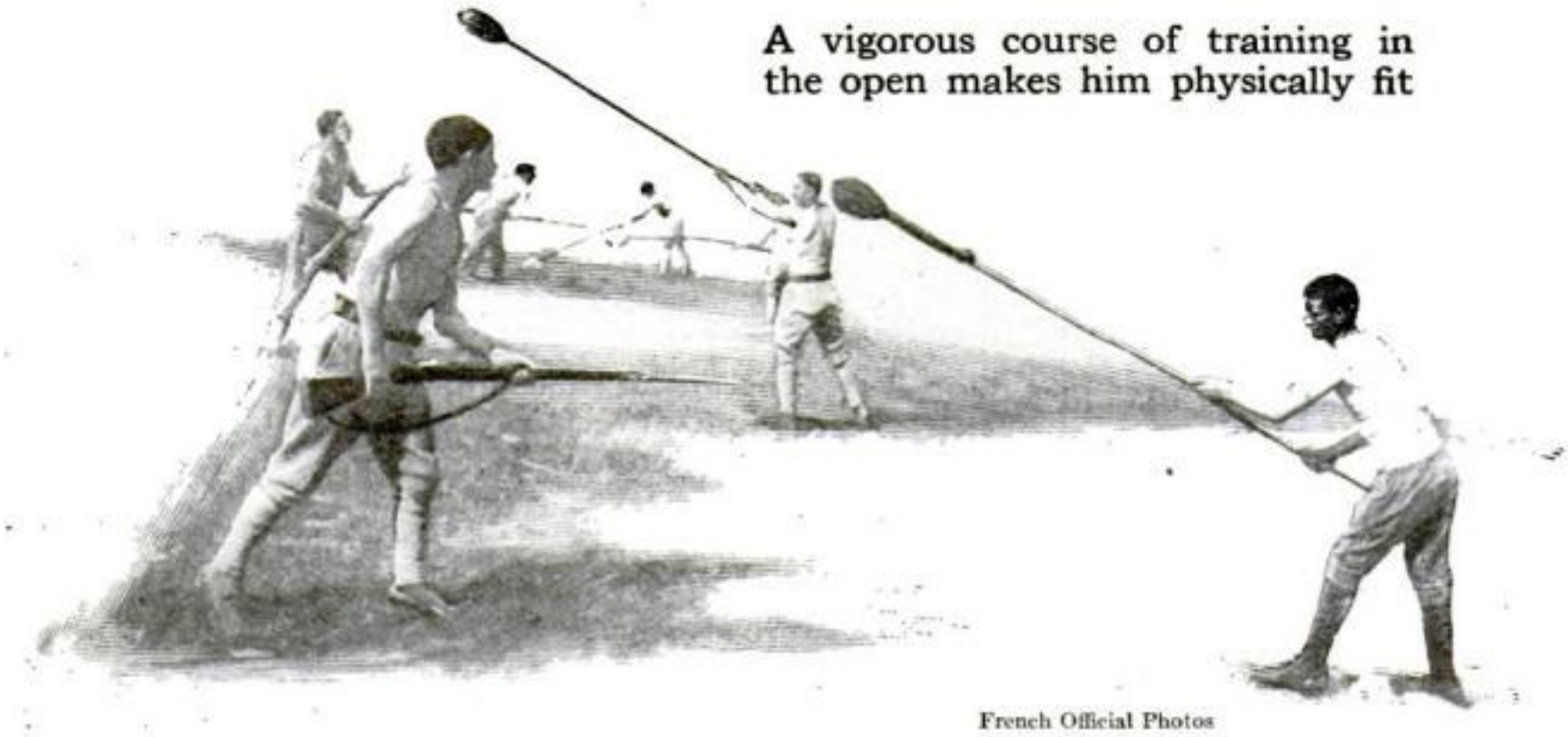
Pueblo Indians climbing a pole to get the provisions which are attached to the top

Non-Flying Air Service Needs Radio Men; Opportunities Wide in Range

RADIO amateurs, the Government wants you. It needs radio operators in the aviation service, not to fly but to receive messages airplanes send back to bases. Any railroad telegrapher, youths with elementary electrical knowledge, those already acquainted with wireless, and of course men with more advanced experience are all possible candidates. A training camp has been established at Camp Kelly, San Antonio, Texas. The course given, extends over a six- to eight-week period, and embraces primary power circuits, secondary power circuits, condensers, oscillations, radiated currents, ether, received waves, receiving circuits, detectors, wave meters, instruments, and in the final weeks requires students to take radio apparatus out in the field and communicate with airplanes under actual flying conditions. Radio repair men and mechanicians are also trained. College graduates with technical education are eligible for non-flying commissions. Additional information may be obtained by addressing the Chief Signal Officer, Washington, D. C. Applicants are enlisted as privates and remain as such until assigned their proper places in a squadron.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

Making the Frenchman a Fighter



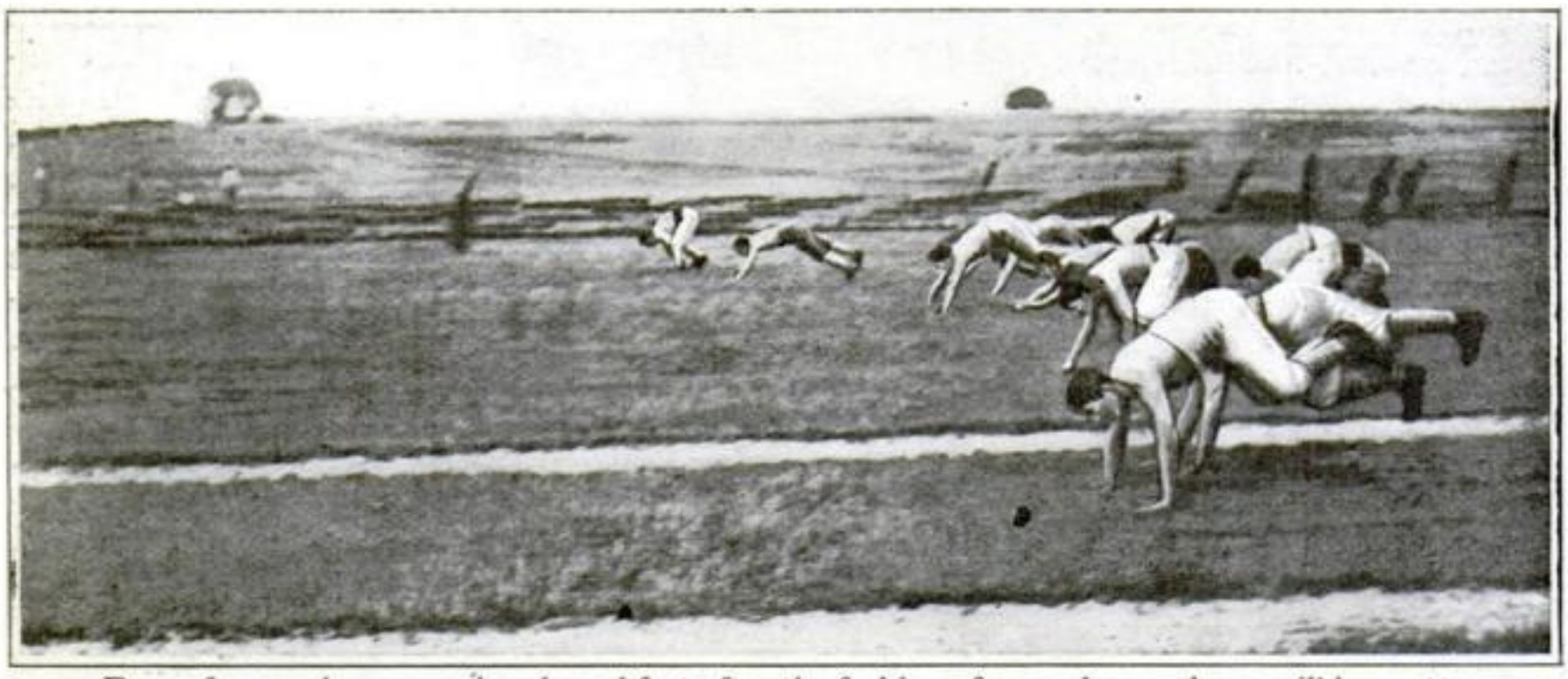
French Official Photos

French soldiers, stripped to the waist, learning bayonet charging by the Herbert method

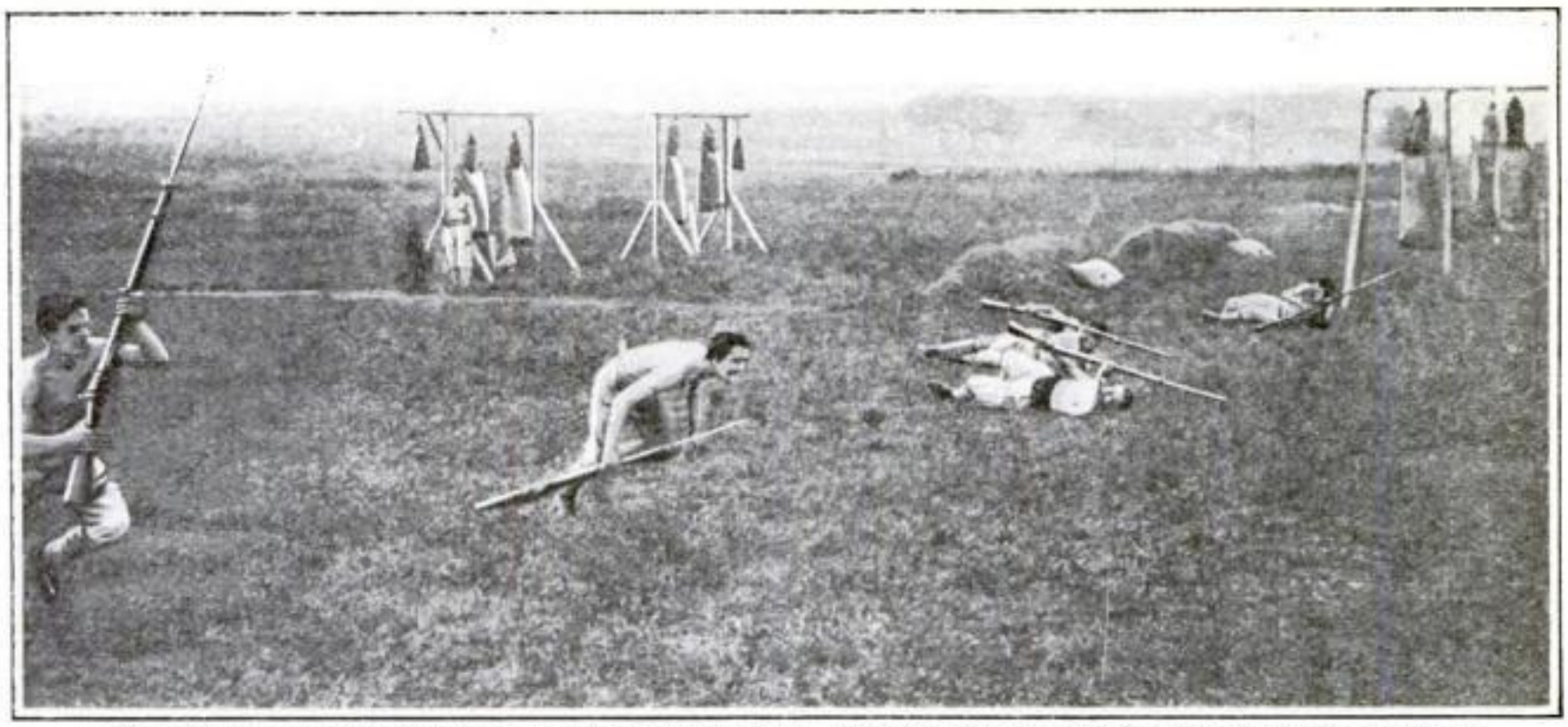
ONE of the military problems France has solved is that of sending back her soldiers-on-leave to the trenches without their having lost any of their value as fighters. In fact, they go back better soldiers than they were before. When the poilus return from the trenches the sense of discipline is suddenly relaxed, to their military detriment. Often the men are highly nervous. The terrific noise of the battles they have been through, and the sleepless nights they have passed have weakened their stamina. Some are excited—intoxicated with success. Others are profoundly depressed. Soldiers recovered from shell shock are more unstrung than others.

All these men must be re-taught if they are to be sent back to the firing line. The time needed for re-education is ten weeks, during which period the soldier is schooled in the very latest methods of warfare.

Just what method shall be used in retraining soldiers is a moot subject. Lieutenant Herbert of the French Navy does not believe in the use of mechanical appliances such as are to be found in the average gymnasium. He thinks that natural methods are best. He takes his men right out into the open and puts them



Run a few yards on your hands and feet after the fashion of a monkey and you will be pretty tired. Yet these enthusiastic Frenchmen do not mind this method of locomotion at all

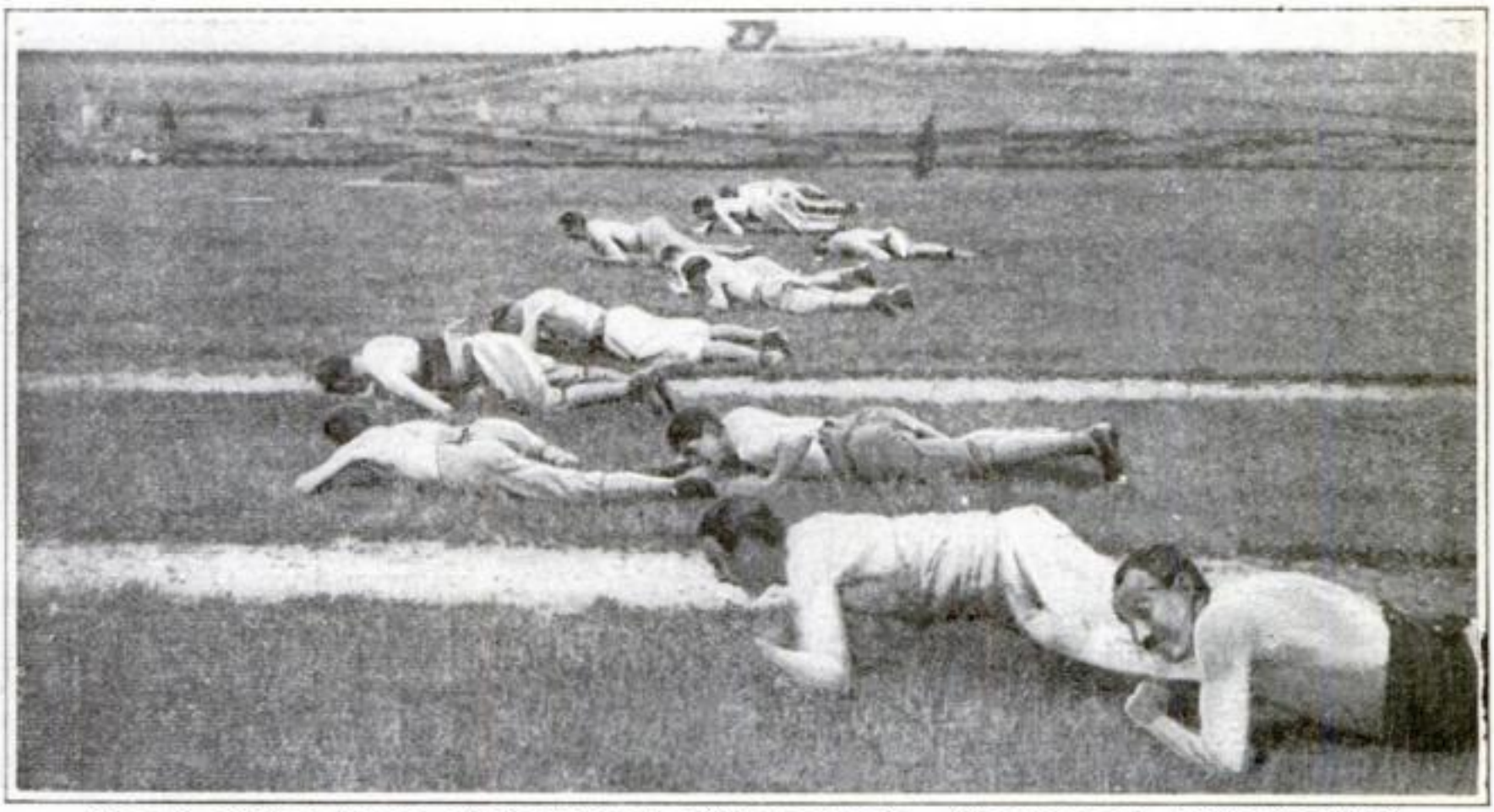


How the poilu is taught to handle the bayonet. Here he is advancing against an imaginary enemy. The dummy figures which can be seen in the background are bayonet targets

through a rigorous course of training.

Life in the trenches is far from easy. The men must be in fine condition if they are to stand the hardships. Herbert wants to bring out the best in every man. First of all he makes the men strip to the waist. This toughens their skins and enables them to stand severe weather. The training consists in climbing trees, running on their hands and feet, rolling on the ground, fording streams and practising military tactics. The men train every day no matter what the weather conditions may be. They are taught to throw grenades, charge trenches, use bayonets effectively and handle all the delicate machines and weapons which have been developed by this war.

As an example of what this training will do, take the case of an attack in a real battle which took place last April. A group of thirty-four grenadiers which was quickly reduced to twenty-six, threw eight thousand, five hundred hand grenades in three hours and a half. If these men had not been in the best physical condition such a feat would have been absolutely impossible.



French soldiers at one of the Herbert military schools. The men are developing their muscles by walking on their elbows and their toes. They always work stripped to the waist

A new sound-producing device. These hollowed cups cleverly imitate the clatter of a horse's hoofs

How the Cavalcade Approaches Behind the Scenes

EVERY barnstorming company has as not the least important part of its equipment a pair of hollowed cocoanut shells, which in the hands of the stage mechanic, sound more like a horse than a horse itself. Now that most of our melodrama comes to us through the motion pictures, along comes an imitator of clattering hoofs to be attached to a stationary organ. It is operated from the keyboard by a lever or button. With the aid of a swell box, the sound can be made to swell or diminish.

The device consists of six cups, the upper three of which are secured to the bellows and the lower three of which are mounted on a solid base. To operate them, the organ player presses a key which causes the first cup to come down with a thud, followed in quick succession by the other two cups. There is no break in the action. The cups are made of maple. The inventor is Harold A. Valkenburg, of Oakland, California.

Ashes From Burned Wood Make a Good Fertilizer

DO not bewail the fact that the price of commercial fertilizers has gone beyond the reach of all except the wealthy farmer. It is because potassium oxide, one of the important ingredients of a good fertilizer, has jumped from four hundred to eight hundred dollars a ton. But any farmer can produce his own potassium oxide from the fresh ash of burned twigs, branches and other parts of such hardwood trees as the beech, birch and maple. It is a very simple process requiring a cheap apparatus and no complex chemical treatment. The College of Forestry at Syracuse will give information to anyone about the process.

New Key Hole Saw Which Will Not Jam or Bind

A NEW saw has been invented by A. R. Brewer, of Northport, Washington. It not only has teeth along one edge, as has an ordinary blade, but the sides and upper surface are toothed also. Made in this way, the saw can cut itself out of any predicament. The toothed sides automatically trim away enough wood to keep the blade from binding as it goes down into the cut. These same toothed sides may be used as a rasp to widen out laterally the hole that is being made.

The saw is designed for both rip and cross-cut work. The pointed end of the blade is channeled out much like a reamer, so that by giving it a twisting motion, it is quite able to bore its own way into the wood in starting a hole. The chisel-like handle provided at the other end, facilitates this action because the blade may be driven into the wood with a mallet if the twisting motion at the start does not prove sufficient.

The toothed sides trim away enough wood to keep the blade from binding

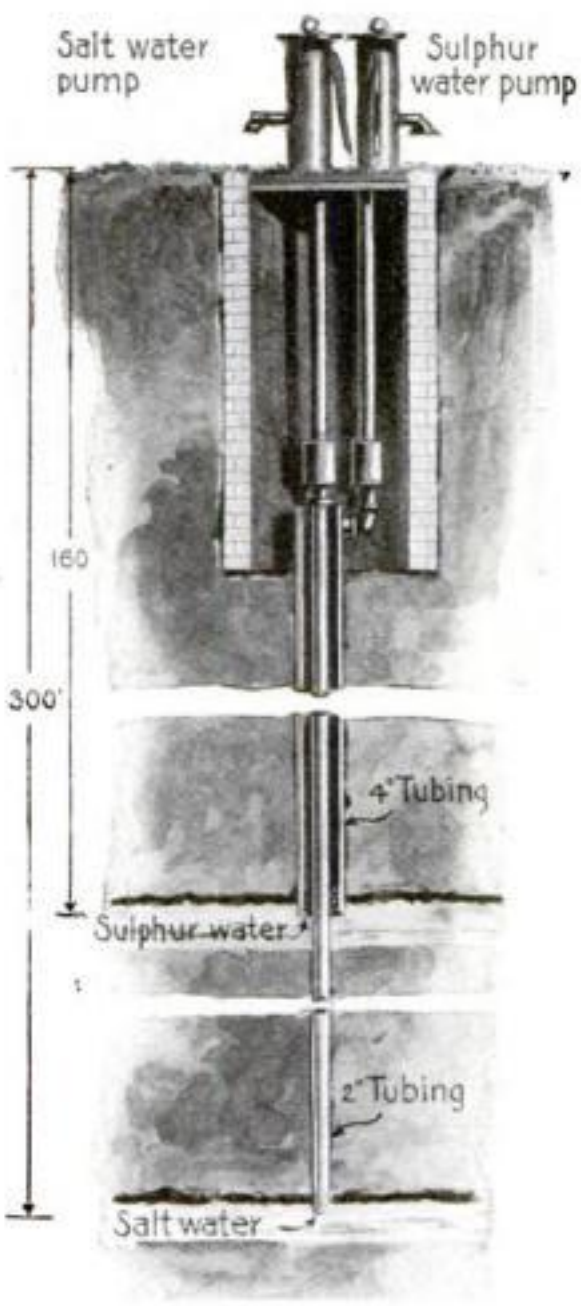
A Well That Supplies Two Kinds of Water

"WHAT'LL you have, salt or sulphur?" This question is appropriate when one does "the honors" at a well at Welaka, Florida, for two kinds of water are "on tap" there.

The well first was drilled to a depth of one hundred and sixty feet. Here ordinary "sulphur" water was encountered. The drill was then carried to a depth of three hundred feet. Here a strong mineral water was struck. In order to use both kinds of water, a small tubing was passed through the upper casing of four-inch pipe and down nearly to the bottom of the well. Both this and the outer casing were connected with pumps. A favorite joke is to give visitors a drink of the weaker water in the first glass and then replace it with the brine in the second.

The United States Geological Survey has records of only about six wells of this kind in the country, but there is no reason why similar wells can not be obtained in regions where the waters in the upper strata differ from those lying deeper.

At Mulford, Utah, there is a "double" artesian well which has a flow of thirty-seven gallons per minute of pure water from a four hundred and fifty foot depth and another of two gallons per minute of strong sulphur water from a depth of seven hundred and fifty feet. A four-inch casing is used on the upper level, and a two-inch pipe extends to the very bottom of the well. These "double" wells have wide uses.

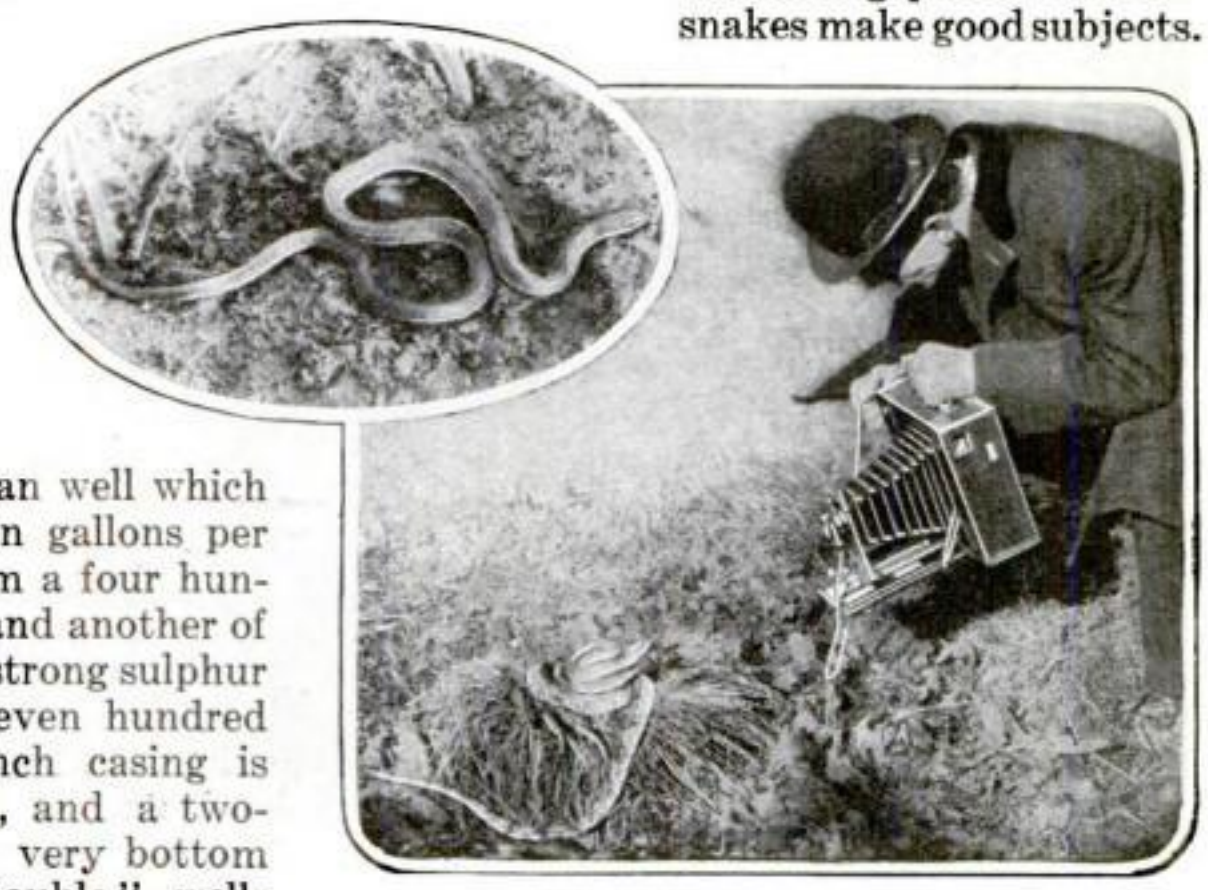


The double piping makes both the sulphur water and the salt water available

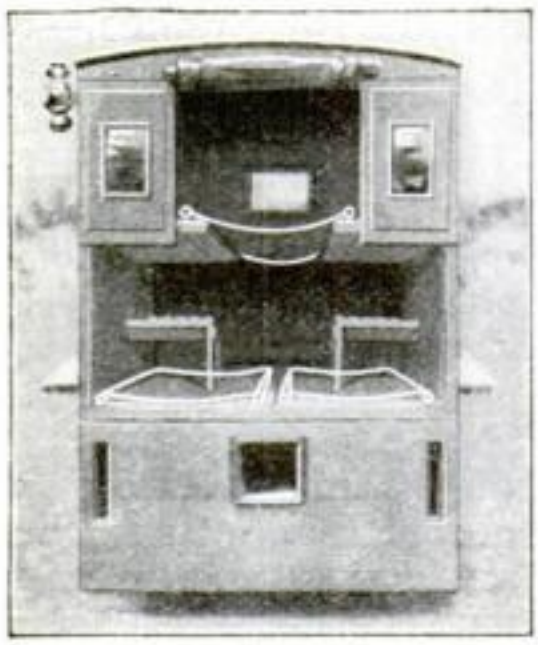
Home Portraiture for Snakes.—Try it on a Rattler

PHOTOGRAPHING snakes in their native retreats is a sport often overlooked by the camera enthusiast. It not only requires a high degree of courage on the part of the photographer to approach his quarry, but much time and patience must be expended before the snake assumes a position that can be readily caught by the camera. It goes without saying that photographing poisonous snakes, such as copperheads, water-moccasins and rattlesnakes, should not be undertaken by a novice, unless he be accompanied by a person familiar with the habits of such snakes.

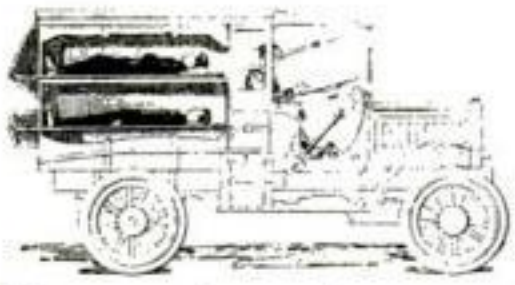
However, it is just as much sport photographing harmless snakes. In the first place, you must know where to look for them, and secondly, having found them you must wait patiently until they get in interesting poses. Watersnakes make good subjects.



The snakes here photographed are harmless, but they are none the less interesting



The new Ford ambulance can not tip over backwards. Fold-down interior seats accommodate patients not badly wounded



New Ambulances Are Shorter Than the Stretchers They Carry

THE tendency of Ford ambulances to tip over backwards, because of the extreme rear overhang of the body, has been obviated in the new standard ambulance used for front-line trenches. The body measures half a foot less than the standard stretchers that it carries.

Four canvas-covered holes are provided in the back of the body, and into these holes the rear ends of the stretchers extend. Three of the holes are in the lower half of the tailgate, which folds down from a step. Two stretchers are carried on the body floor; their outside ends each extend into the holes on the outside, and the two adjacent ends into the center hole, which is twice the size of the side holes. The third stretcher is carried above the other two and in the center of the body. A similar, though larger, canvas pocket is provided to prevent the upper stretcher and its occupant from slipping out.

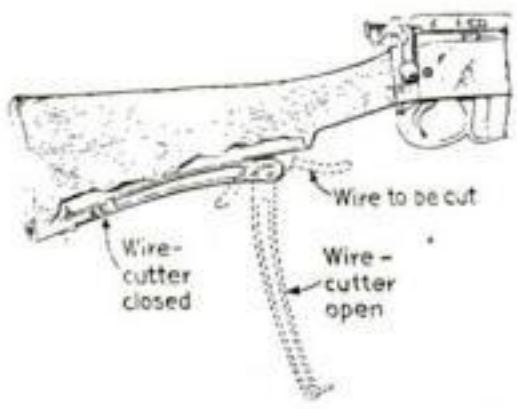
Wire Cutter Attached to Gun

WHEN the hail of shells upon the enemy's entanglements does not destroy them entirely, the soldier himself must complete the job. Hence it is that, along with a score of other instruments initiated in the present war, the wire cutter takes its place as part of the modern soldier's equipment.

While these new instruments are necessary, they are nevertheless a great encumbrance. A step in the direction of minimizing the unwieldiness of a number of separate instruments has been taken by Frederick A. Warner, of Halifax, Nova Scotia. The bulky pair of shears has been converted into a simple lever, attached to the soldier's gun in a groove underneath the stock. The hinged end of the lever, which lies towards the forward part of the stock, is pivoted between two short cutting blades. When a piece of wire is placed across the blades and the lever is swung inwards, the barbed wire is severed instantly.

As long as the soldier is in action, he keeps his gun steadily pointed at the enemy.

The soldier backs the two short cutting blades against the wire and severs it



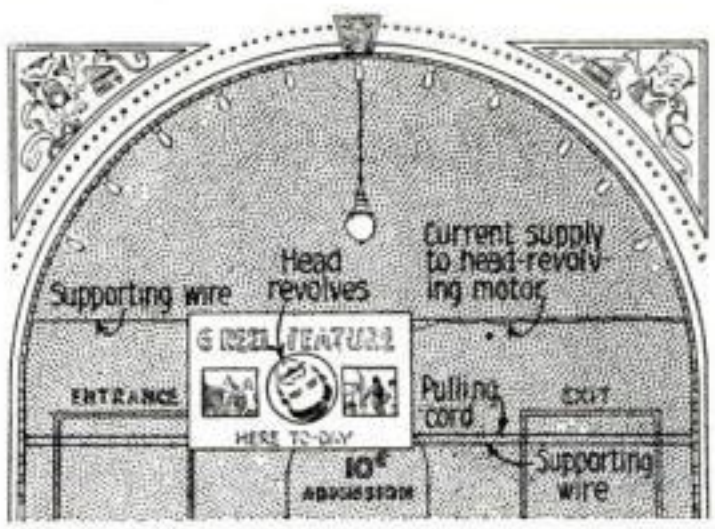
When he comes to an entanglement, all that he has to do is to back the blades against the barbed wire in order to sever it. Between cuts, the soldier keeps up his fire upon the resisting trenches, when in a position to aim with any degree of accuracy.

All Kinds of Commotion at This Theater; Electric Signs Cause It

MANY things would interest you if you happened to pass a certain moving picture theater out in a California city. For instance, a big cloth sign, mounted upon a framework, keeps moving back and forth on suspension wires above the doorway. Then too, the head of the actor depicted on this sign has an odd way of turning 'round and 'round in the most eye-arresting manner. Mere movement seems to be a good advertisement, for crowds of people are attracted by the sign.

The rectangular sign filling most of the picture is moved back and forth by an electric motor. The head revolves

The revolving of the actor's head is simple enough. A small fan motor back of the sign does the work. Suitable pulleys and cord-belts reduce the speed. The sign, revolving head and all, is pulled back and forth by cords at each end, which run to a winding drum concealed at some point about the front entrance. The drum is operated by a second motor. When the sign reaches the right or left end of its travels, it trips a switch which reverses the driving motor and sends the sign in the opposite direction—this operation being continuous and automatic, of course, as long as the current is turned on. Motors may be reversed by reversing the field windings, by shifting the brushes or by rearranging phase connections. If you desire to experiment with electric signs, ask your local electrician about the motor.

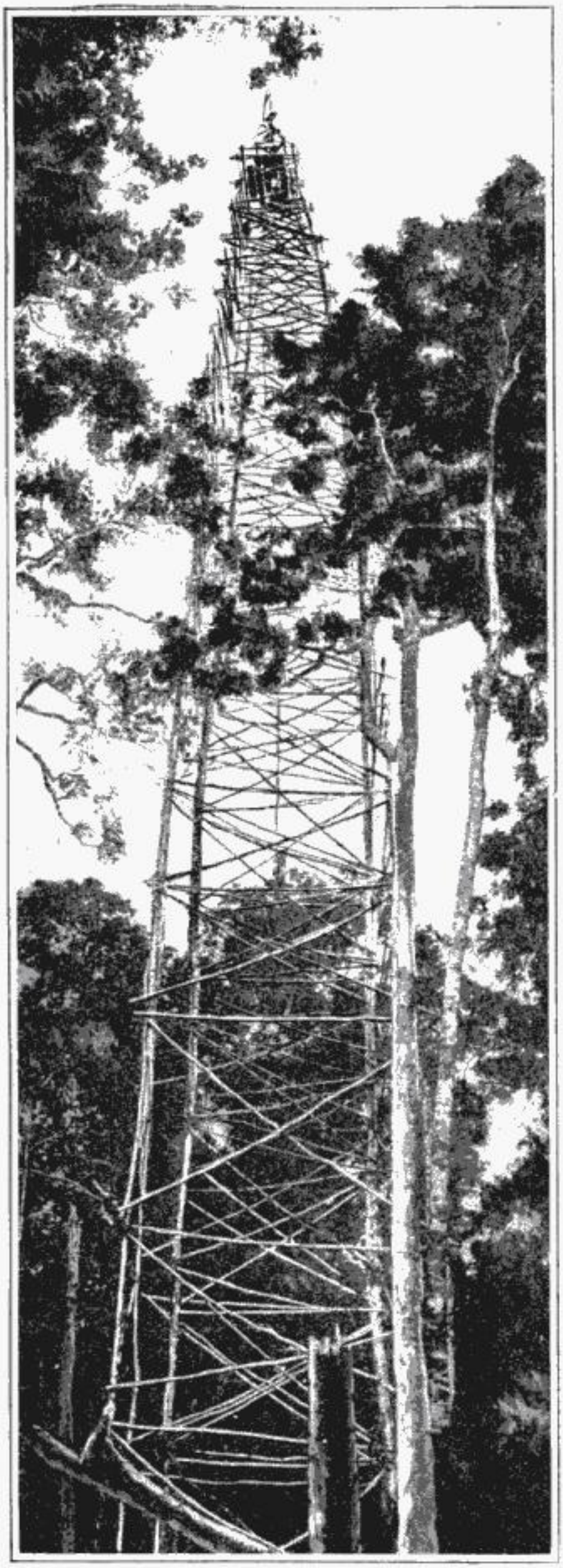


The sign in position on exterior of theater. It is simple in construction

Shells That Burn and Suffocate

THE so-called "tear shell" used in the war in Europe is a hybrid between poisonous gas and the high explosive shell It is an ordinary shell of high bursting qualities which is filled with a charge of intensely irritating chemicals. These, as they shower from the shell upon the men in the trenches, affect the eyes and cause great discomfort. The men who are attacked unprepared, become overpowered almost instantly, for none can stand the intense irritation for more than a second. The tear-ducts open to wash the eyes, but their action has little effect upon the strong chemicals.

The nature of the active substances used has been the cause of much speculation. It is believed that very common substances are employed, for such unmysterious edibles as onions and peppers, can produce intensely irritating effects on the eyes. Red pepper abounds in Hungary, so it is likely that some of it is used because of its cheapness. This pepper is not only irritating, but it is known to give off an extremely pungent odor which renders the air difficult to breathe. Fortunately, preventive measures can be adopted. The hoods that have been used over the head during poisonous gas attacks are just as effective here in mitigating the action of irritants.



Filipinos built six of these towers so that the engineers of our Coast and Geodetic Survey could survey an island of dense jungles

Building Eiffel Towers in the Philippine Jungle

THE accompanying photograph illustrates one of the many hazardous tasks which the engineers of the Coast and Geodetic Survey must undertake in order to overcome the obstacles of nature. Six towers, similar to the one illustrated, and ranging in height from 190 to 230 feet, were built to enable the surveyors to get long sights in the flat jungle country of southern Palawan, an island of the Philippines.

The feat is all the more remarkable when one considers the fact that the work was done by half wild Filipinos, many of whom were unable to understand English. Under the supervision of two American officers, the towers were built entirely of rough trees and saplings cut in the forest and carried to the station on the shoulders of the natives. Wire and nails brought from the Coast Survey vessel were used to fasten and secure the structures.

Some of the towers were located back several miles from the coast, so that the party had to camp on the spot. It was necessary to "pack" all of their outfit and provisions, even to drinking water, through the dense jungles and swamps where it was impossible to travel unless two or three natives went ahead with their bolos and cut trails. The natives were found to be excellent at tower building; they could climb up and around with almost as much agility as monkeys. In spite of the dangers naturally incurred in working on such crude structures and at so great a height, enough natives always volunteered to "work topside." The risks they ran would make those of our better known steeplejacks and steel workers look tame by comparison.

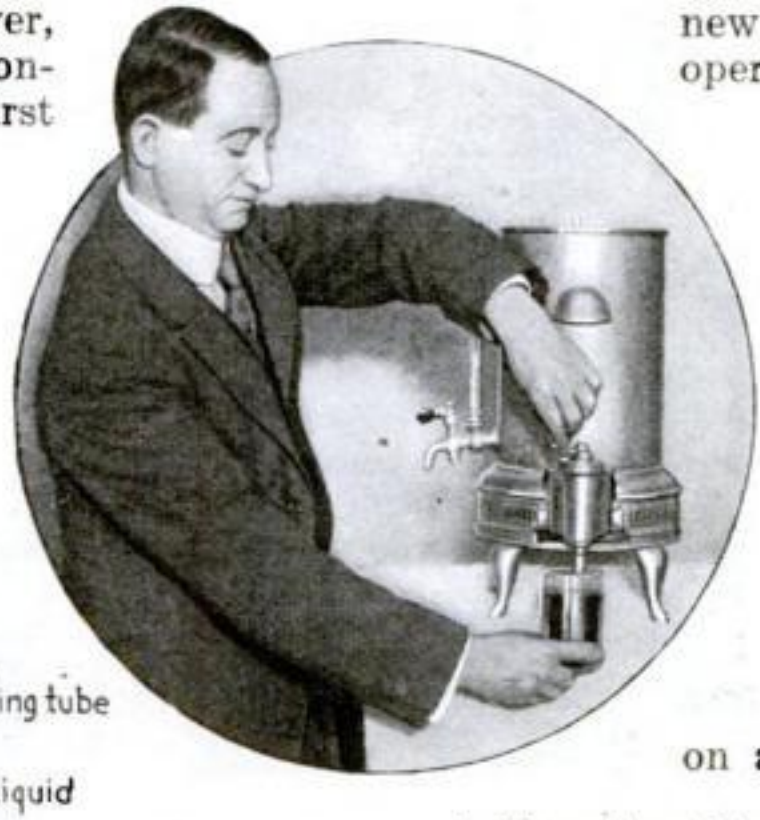
The towers are composed of two separate structures, one inside the other. This is necessary in order that the theodolite (the instrument used to measure the angles to far distant stations) may be free from vibration. Mounted on top of the inner tower, it permits the observer to walk on the outer one without shaking the instru ment and disturbing its adjustment.

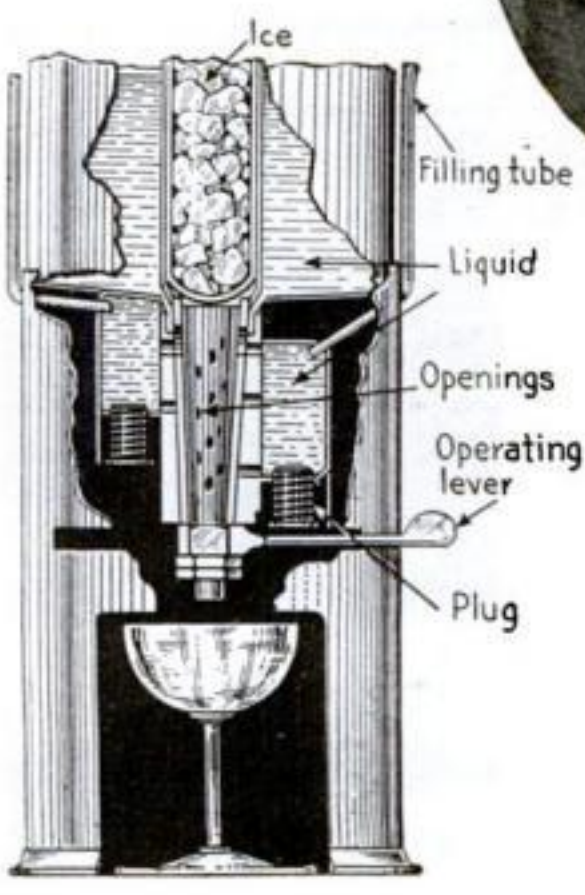
The Brainless Drink-Mixer. It Never Makes a Mistake

IT is said that an efficient drink-mixer is a rarity because it is practically impossible for a man to make two drinks, composed of the same ingredients, taste alike. But with the drink mixer invented by Nicholas Jacovatos, of New York city, the mixing is done automatically and carelessness is eliminated.

His drink mixer resembles an ordinary ice-water cooler. In the interior are a number of compartments holding different flavors or liquids. The compartments are filled through tubes which extend to the outside, avoiding the inconvenience of lifting the cover to replenish the supply. One side of each compartment rests against a chamber containing ice, which keeps the contents at a constant temperature.

To obtain a mixed drink, the operator turns a lever, which causes a valve connected with it to mesh first with one compartment and then with another, until the several liquids which make up the desired concoction have all been released into the glass.





Above: To make your mixed drink you simply turn the little lever

At left: The interior compartments and mechanism of the mixer

Raising water by the oldest of treadmill methods is still common in China. Hundreds of such mills are in use

A Twentieth Century Treadmill in China. It is Run by Man-Power

WHILE all the western world is echoing the slogan "Do It Electrically," and pulling down old machinery in order to install new devices requiring fewer operators, China is still employing the man-power tread-mills shown in the accompanying illustration. Here men, women and children take turns keeping the mill going and thus pumping water into the reservoir seen at the left of the picture.

The four treads of the mill are supported on a crude framework.

A Floating Match-Safe Made from a Shaving-Stick Container

CERTAIN brands of shaving sticks come in strong metal containers which may be converted into useful match-safes for the camping outfit. These boxes hold fifty matches, which are enough for the use of one man for two weeks.

Although the cover fits well, the match-safe will not be waterproof unless a strip of adhesive plaster is wound around where the cover joins the box.

Fake Messages from the Spirit World

How mediums read "messages" sent them to be answered

By Hereward Carrington

SCENE:—The rooms of a professional spiritualist. The medium asks a number of persons to write out questions on a piece of paper and to fold up the papers. After the papers are gathered up, they are placed on the small table or "altar" in front of the medium. The eyes of the medium are bandaged. She cannot see anything—apparently. The investigators take their seats, and the "readings" begin.

One by one, the medium picks up the papers, places them to her forehead and proceeds to tell what question each contains. Miraculously enough they are the very questions asked by the writers. But the medium does more than read the writing on a folded paper. She proceeds to give advice, or more often mere impressions, which are taken as partial or complete answers to the questions by emotional and imaginative listeners. With the answers, then, we need not concern ourselves. They consist only of vague advice and guesses.

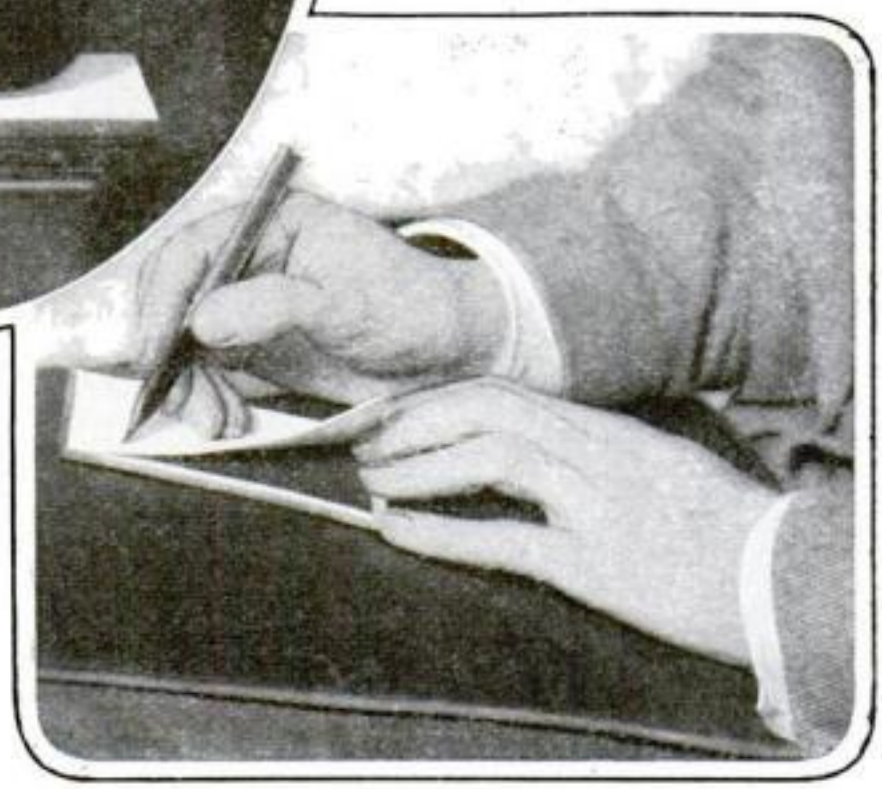
How, then, does the medium find out what is written on the carefully folded papers?

There are various ways. The illustrations disclose some of them.

Under cover of a pile of folded papers, or perhaps of some small ornament on the "altar" the medium quietly unfolds the pellets, one at a time, and reads them under the bandage. Folding them up again, she places them to her forehead and pretends that she is only then making out their contents with the greatest difficulty. The spectators are impressed!

But suppose the medium's head is covered up by a thick sack. Surely she can't see. What then?

In this case, the trick is rendered possible by the very means which seem to make it impossible—as so often happens! Under cover of the sack, the medium has taken from under her skirt an electric flash lamp, and by its aid she reads the contents of a number of questions she has concealed. In this case, a number of dummy (blank) pellets are left upon the table, to take the places of those sur-



How can she read with a sack over her head? It's easy—with a flashlight. At right, a medium's pad with its revealing carbon paper

reptitiously abstracted, so that the number remains approximately the same. This is done either by the medium herself or by the assistant, who collects the pellets and superintends the blindfolding of the medium.

Often the original slips *are* left on the table, and *no* dummies are substituted. If this is done, all of the questions must be written on previously-prepared pads containing a carbon-sheet so that an imprint of the question is obtained. Sometimes the under side of one of the sheets of paper is prepared by soaping it thinly. This is pressed upon the lower sheet; and the medium has only to rub the lower sheet with lamp-black or charcoal to obtain an imprint of the message.

If the "message" is placed in an envelope, and this is sealed, the medium can often see what is written on the pad simply by rubbing over the envelope with a small sponge dipped in alcohol. The envelope will at once become transparent, Nothing will do but alcohol, which dries out almost at once, without wrinkling the envelope, which can be stood upright, on the table, for a few moments, while drying,

Deep mystery, but not to those who know the little ways of fake mediums

To obtain an imprint of the message rub the paper with lamp-black or charcoal

Reducing the Egg Loss Due to Breakage in Shipment

AS spring approaches, the cackle of the corn-belt hen is the preliminary announcement of the shipping of millions of white and brown eggs to the large cities of the East. The eggs leave their shipping points packed in cases supposed to insure their safe delivery, but the fact remains, as established by Government investigations, that two dozen eggs out of every thirty dozen cased, reach their destination in a cracked, mashed, dented or leaky condition.

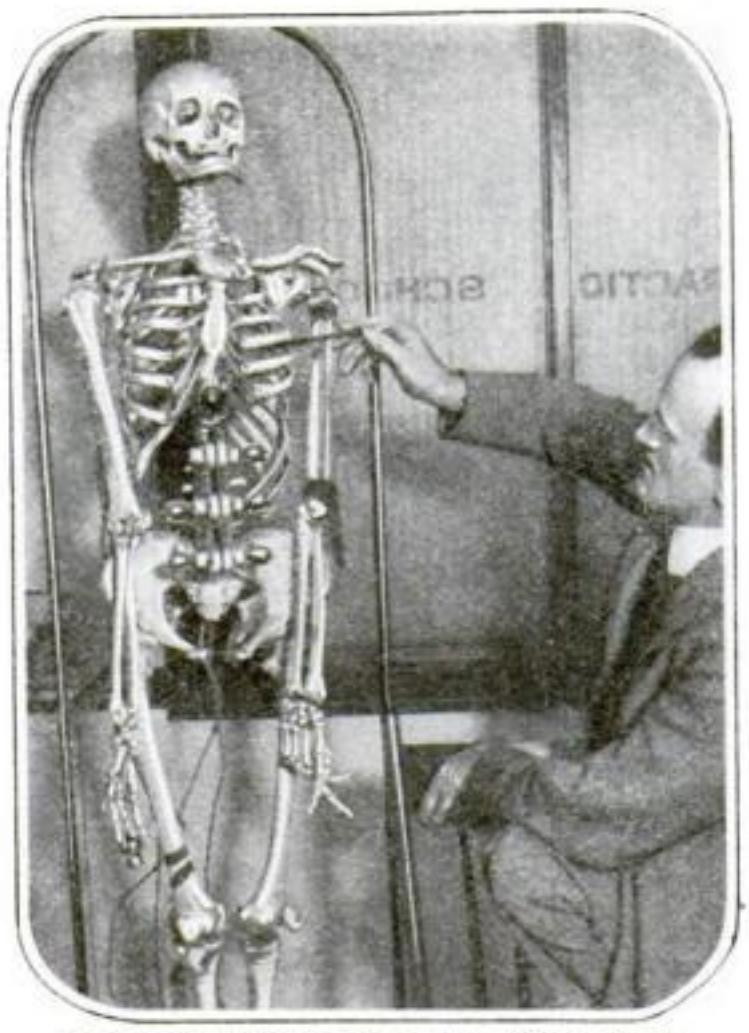
For New York city alone, this means that one hundred million eggs are annually found to be in a damaged condition following their arrival from the shippers. This causes an annual loss of three milliondollars to poultry dealers. An inspection of crates shows that they have been carelessly nailed up. On the other hand, the Government inspectors find that nineteen eggs in each case are cracked before being loaded on the car, and that careless packing in old and flimsy cases accounts for the additional breaking of five more eggs in a case.

To eliminate this tremendous loss, shippers are resorting to all sorts of packing methods. Some have found the old-fashioned splint basket, when packed with excelsior as a shock absorber, to cause the least damage. For one hundred eggs or larger shipments, a barrel with the eggs packed securely in excelsior, has met with partial success. The ordinary egg crate has been discarded where shipments are made over a considerable distance. Some shippers are packing each egg so that it is the center of a ball of excelsior. This is an expensive as well as a laborious method but it does insure full protection for the exceedingly fragile egg.

What's the Matter With You?

The illuminated skeleton tells. The organs are indicated by incandescent lamps

DR. RATLEDGE, of Los Angeles, has a novel and rather startling method of explaining to you what he thinks is the matter with you. He hangs a skeleton in a frame of piping and indicates the positions of the vital organs by means of incandescent lamps. Small lights are placed in the eye sockets, and long lights are placed along the arms and legs.

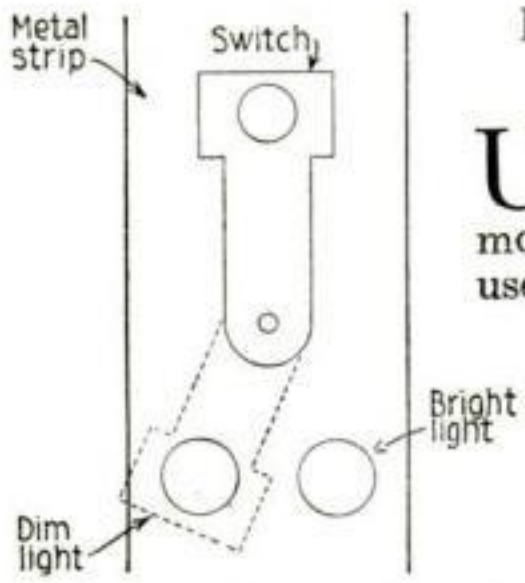


Current is turned on or off to indicate a healthy or diseased condition

Along the spine, where the many nerves branch off to the various organs, are placed electric switches which control the various lights. To illustrate what happens to the vital organs when the nerves leading from the spine become pinched or otherwise injured, he turns the switch so that a very small amount of current is supplied to the particular light that represents the organ which is supposed to be diseased or misplaced. This lessening of current causes the light to burn very dimly. This is supposed to illustrate the manner in which the force flowing to the vital organ is shut off when the nerve leading to that organ is in any way obstructed. To illustrate what happens when this obstruction is removed by the manipulations of the spine, the switch is turned over a notch to supply more electric current and cause the lamp to glow brightly again. To explain what happens when a nerve is so pinched that no nerve force can pass, the switch is turned so that all current is cut off which extinguishes the lamp. The switch works somewhat like the familiar high-and-low light that burns brightly in one position of the switch and low in another.

There are five switches, each working independently of the other. For instance the light representing the heart may be burning brightly, but the one representing the stomach may be exceedingly dim, thus illustrating the fact that the current leading to one vital organ may be exceedingly strong while the current leading to another may be very weak.

We are not in accord with the doctor's medical theories, but we think his apparatus is one that can be employed to advantage in driving home knowledge to people who cannot understand the jargon in which doctors usually manage to conceal what they think they mean.



Switch on spine swinging to contacts varies brightness

Licking Stamps Is Very Unsanitary

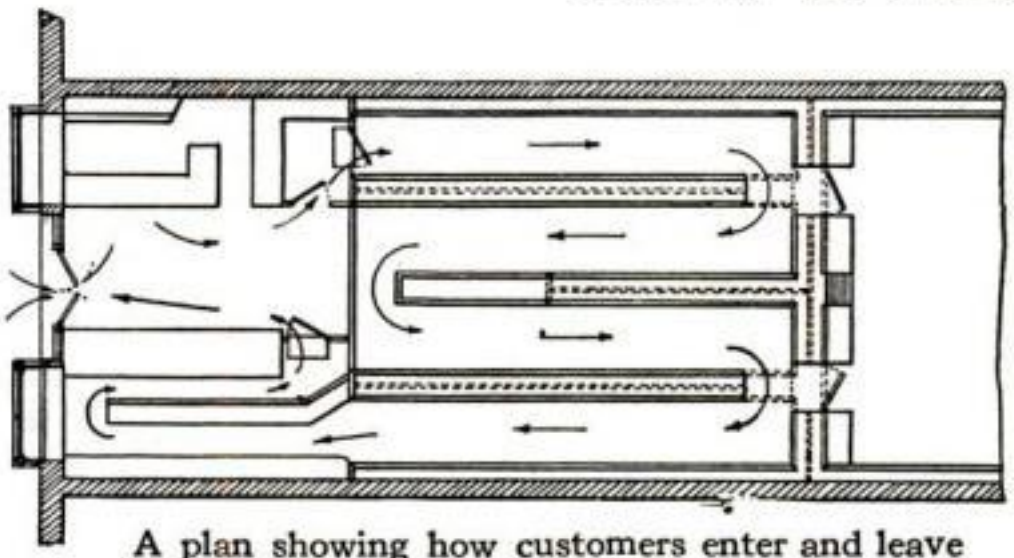
USE a dampened sponge to seal your letters and to moisten the stamps. The glue used on stamps and evelope flaps is made of bones and hoofs of cattle, and all sorts of rags are used in paper. Besides, although they may have been sterilized, the articles pass through many dirty hands while on their road to you.

You Run This Store Yourself

But there is a cashier at the door

IN these days of conservation, it is very appropriate that a new grocery store—a wasteless grocery store—has made its appearance. It is the invention of Clarence Saunders of Memphis, Tenn. The grocery which Mr. Saunders has patented, lowers the cost of operation for its owner and lowers the cost of food for the consumer.

Saunders' grocery runs itself. There are no clerks. When you go into the store you enter a turnstile, pick up a basket and are free to do your shopping without any interference. No polite clerk persuades you to purchase something you don't want. Every article is labeled plainly and displayed on the counters in such a manner that you simply help yourself. You make your selections in your own way.



A plan showing how customers enter and leave the first grocery store which ever was patented

The aisles are so arranged that you progress through the store in a given direction. When you come out, you find yourself opposite a checking and settlement counter. A clerk checks off your purchases and you pay him for what you have taken. If you have made no purchases, you simply pass out.

Naturally the overhead expenses are much less in a store of this character than they would be if a staff of clerks was kept in attendance. The waste is much less than it is in the average grocery store. In weighing food hurriedly there is often a loss of a little of the substance being weighed, as well as the danger of the weight being over or under the desired amount. When the material is weighed without hurry or anxiety, the results are more satisfactory.

The customers select their own groceries and carry them to the checking counter where they are paid for. The customers then wrap up their packages and carry them home

Soothing Our Soldiers Electrically

Electric cages will put new energy in them when worn out. Trench-foot and shell shock also to be aided electrically

By Lloyd E. Darling

OF course, you wonder what the picture on our cover means. You see a medical officer operating electrical apparatus, and also a marine inside of a cage. What's the marine in for?

So we introduce to you a little known development in the field of science.

Government officials recently decided to establish in all American war hospitals in this country and Europe, electrical apparatus for the treatment of wounded and ailing army and navy men. And the peculiar part about it is that the apparatus to be used is not unlike that which every young experimenter in this country has played with for a long time past. The coils and condensers of the boy's wireless apparatus are familiar objects; also the glass-plate static machine that he inherited from some lightning rod demonstrator, or that he made himself. That such machines as these, though naturally of larger size and better quality, have a practical usefulness in an army hospital is unexpected.

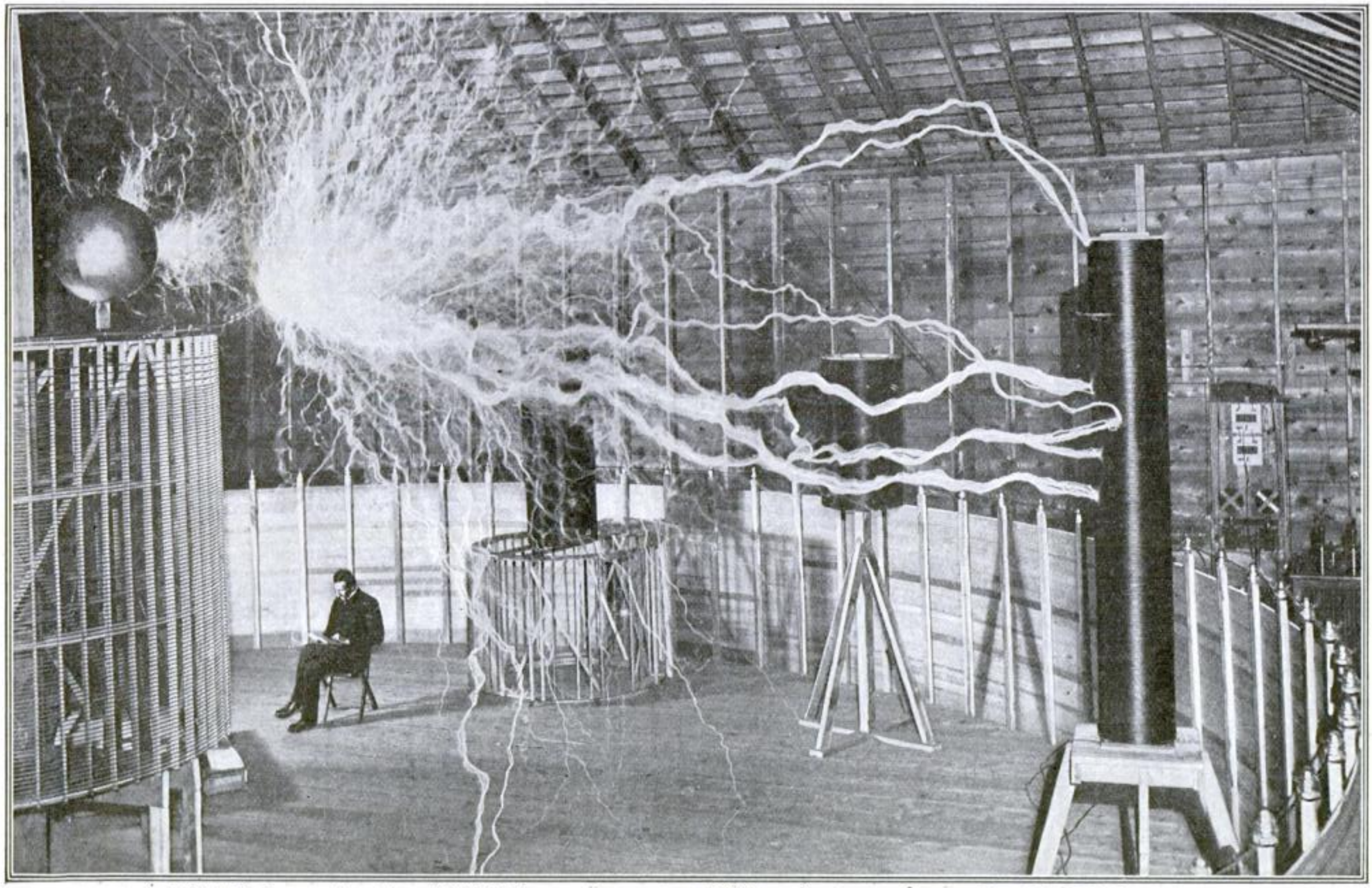
Electrical currents of some types are of special benefit in the many ills common to soldiers, and in particular to those that do not yield readily to ordinary treatment. For instance, trench foot. What is trench foot? It is a disease likely to afflict any of our men who have to stand for hours at a time in cold, water-filled trenches and in the slime and ooze that covers battle grounds. At first, a man loses all feeling in his feet. They swell and pain. Gangrene may develop. Then there's rheumatism, sciatica, lumbago, the "trench back," which frequently results when men have been buried alive, frost bite, shell shock, neuritis, wounds from which there is a large discharge of pus; sprains, contusions, skin diseases, hysterical paralysis, tissues broken up by irregular bullet wounds, and so on. Don't get the idea from this array that electricity is a cure-all and the long-looked-for panacea. It is only lately that the curative properties of electricity have been systematically utilized. It takes a head to be both a doctor and an electrical expert. This is the principal reason why the system has not been applied before. But as far back as 1907, in the Moroccoan war, the French found electrical methods invaluable. In this war, they have been developed to a still greater extent.

Most men have heard *a little* how electricity may be used to benefit and cure certain ills. They know that doctors—some of them quacks—sometimes use electrical apparatus and that there is always a great to-do around such places, what with the sparks and everything. But just what does it amount to?

Says Dr. William Benham Snow, an authority on the subject:

> Electricity operates in three principal ways in the curing of disease; mechanically, chemically and thermally. These are the same actions as electricity brings about among machines. In other words, the mechanical result produced is an actual movement of or in the flesh, due to the direct stimulation of the muscular cell, or as a result of the nerve and muscular mechanism acting together. Contraction results. Chemical effects may be of the electrolysis order, or in the nature of cooking, or may be actual chemical reactions within the cells as a result of the electrical stimulus. Thermal effects may border on those of chemical nature, but especially result in increased blood circulation through an affected part, stimulating greatly growth of bacteria-destroying blood cells, and so on. The especial advantage of the heat produced as a result of electrical apparatus is that it may be made to permeate an affected part in just the right way. The field for electrotherapy has widened immensely since the war began.

The man on our cover is *surrounded* by electricity. He sits in an invisible electrical field, produced by what is known as a d'Arsonval apparatus, much like a Tesla coil, except that the current is greater. The man in the cage is permeated through and through by the electrical field. You know if you take an ordinary electric light current and send it through a small coil of wire in which is an iron core, you can heat the core red hot if the current strength is great enough. Eddy currents are set up in the core.



Nikola Tesla experimenting with high-frequency apparatus. Millions of volts come from coil at left. His invention of the Tesla coil made possible one whole branch of electrotherapy. Here he is transmitting power wirelessly

iron molecules are slow moving and cannot adjust themselves rapidly enough to keep up with the fast alternations of the current. As a result, they jostle one another, and heat is developed.

The man inside this d'Arsonval coil is somewhat like the iron core of the familiar coil. Every cell in his body is being stimulated just as were the molecules of the iron core. He feels no pain, because high frequency currents have the peculiar property of going through a man without his feeling it, yet stimulating the functional activity of all his cells and organs immensely.

D'Arsonval coils are of particular value in treating hardened arteries and similar afflictions. But this is not the only apparatus the electrotherapists now use. X-Ray machines, electric lights, static machines, Tesla coils, vacuum tube electrodes and specialized variations of these are all a part of the regular equipment.

The young man of electrical or mechanical bent will find electrotherapy an interesting field. It is as attractive as radiotelegraphy. But the subject should be given sound study. The shallow knowledge of quack doctors brings trouble. Knowboth the medical and the electrical ends well.

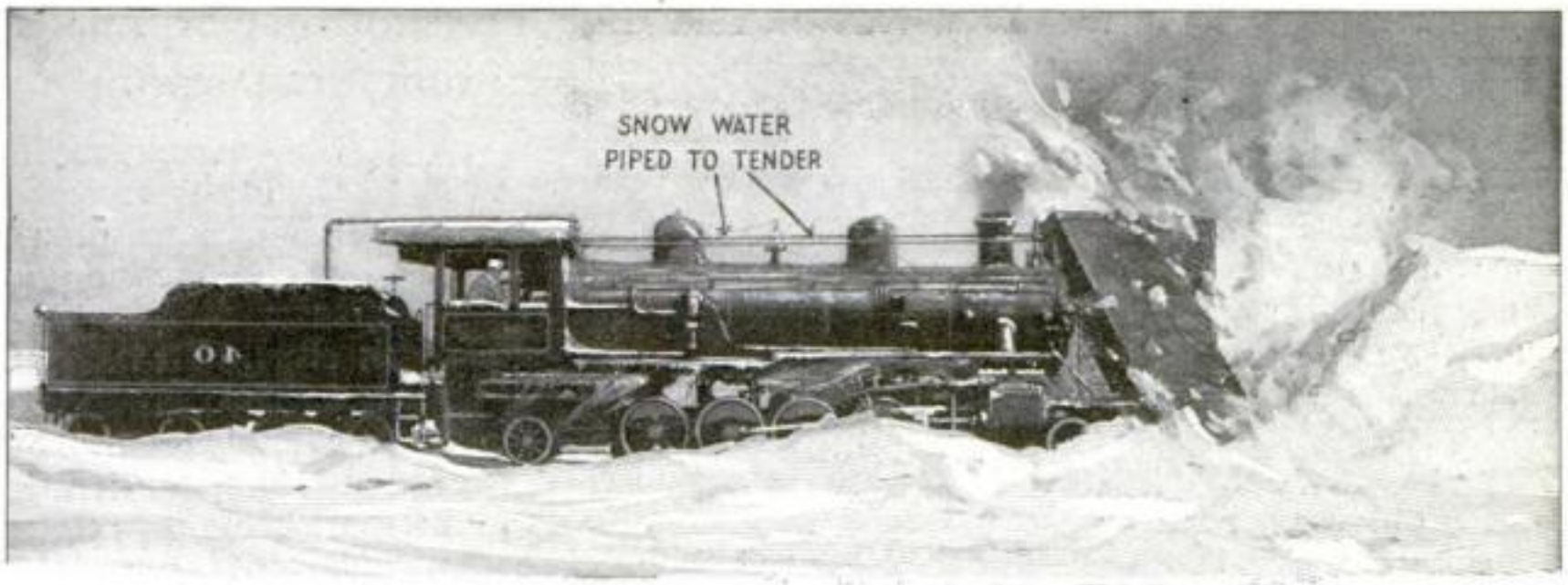
For Recreation Only—Detroit's Innovation in Buildings

WHAT is said to be the largest establishment in the world set apart for recreation alone, has recently been erected in Detroit, Michigan. The second and third floors are equipped with one hundred and five billiard tables. The fourth floor is for ladies and has twenty-two regulation tournament bowling alleys. All the employees on this floor are women, including twenty-two women pin setters. The fifth, sixth and seventh floors have twenty-two regulation bowling alleys each and offer unusual accommodations for league and individual matches. There is also a restaurant, a cigar store, soda fountains, a barber shop and a reading room. For exhibition games and lectures, a billiard amphitheater is provided.

The largest building in the world set apart for recreational purposes alone

An innovation has been made in the lighting system, which throws a diffused light over the floors devoted to bowling, the brightest light being shed directly on the white maple pins. This is a great aid in aiming the shot. The alleys are numbered so that the players have no difficulty in locating the proper alley from any point on the floor.

There are twenty-two women pin-setters in the ladies' bowling alley which is fitted with every convenience



Mount a snow plow in front of a locomotive and simply melt away all the snow drifts you encounter. An inventor has provided the extra apparatus that is necessary

Just Melt a Snow Bank Away. But It's Not a Simple Process

JUST now when railway men all over the country are struggling with overpowering snow storms, we know they will be interested in a Middle-Westerner's invention whereby all their troubles may literally be melted away. His idea is to mount a snow plow in front of the locomotive—a snow plow provided with innumerable steam jets by which all snow encountered may be rapidly reduced to water. It is easy to do this, merely a matter of having coal enough in the tender.

The inventer provides pipes by which the water accumulated, may be delivered at will, to the tender, or distributed freely along the right of way to freeze and hold down drifts. Perhaps the blowing action of the steam jets may assist a plow in loosening up its obstacles. But when the disposal of snow by melting action alone, and with steam as the source of heat, is considered, the question of practicability arises.

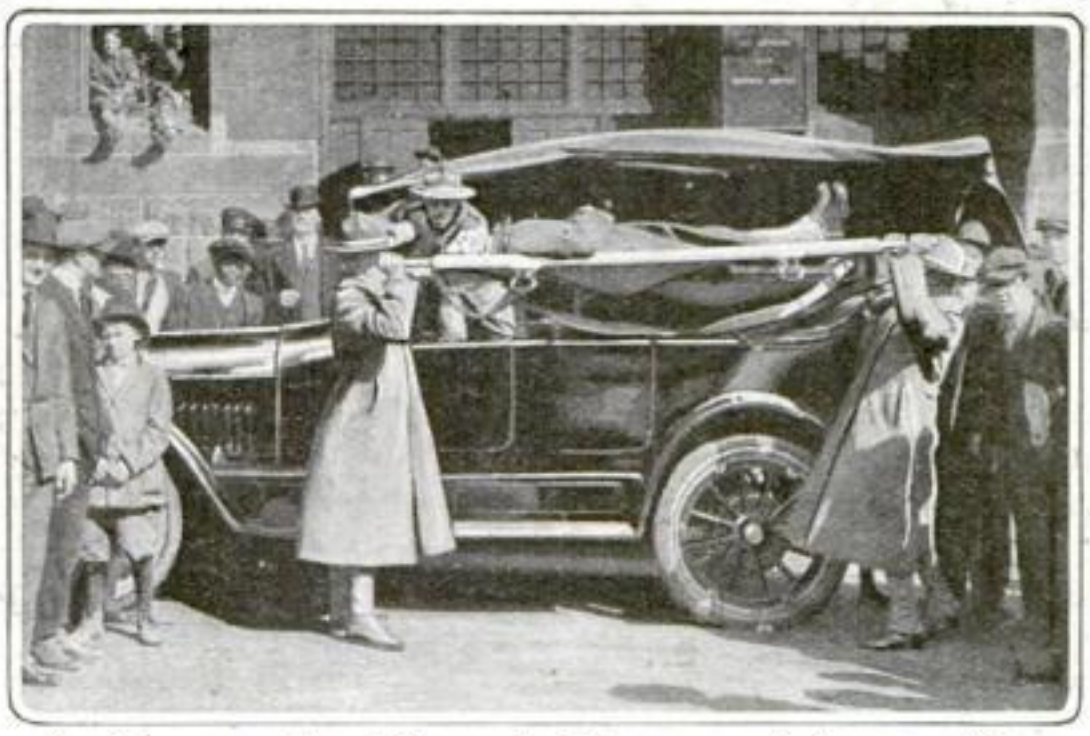
It takes eighty calories of heat to reduce one gram—a small teaspoonful—of ice at 32° F. to water at identically the same temperature (32° F.), or as much heat as it afterwards takes to raise the teaspoonful of (now) water from 32° F. to about 175° F. In other words, ice takes an immense amount of heat just to melt it. Of course, snow isn't *literally* ice, but as an almost limitless absorber of heat it is a close rival.

Good strong rotary plows are proving very useful as disposers of snow.

Your Automobile Can Be Made Into an Ambulance

ANY five-passenger car can be made into an ambulance that will carry two men, by attaching a gas-pipe framework, invented by Captain Gans, of Philadelphia, Pa., an officer in the Medical Corps.

The stretchers are slung from the racks. The light variety weigh not more than fifty pounds.



A pleasure automobile made into an ambulance. Two wounded men can easily be carried on the stretchers

Beating the Coal Dealer with Paper "Coal."

HOW to save one-half the coal bill and utilize the accumulations of waste around the house is suggested in the use of a simple press which converts waste paper, newspaper, letters, torn wrapping paper, old cardboard, old cord, rope or anything else that is combustible, into compressed bricks for burning in the stove or range. When used in combination with coal, the paper bricks make a very hot fire.

When pressed into bricks newspapers and other waste will burn like coal

Rags and all burnable waste are first dropped into a pail of water. When they are thoroughly soaked, they are taken out of the water and stuffed into the cylinder of the press. The wheel is then turned, forcing a piston against the wet waste, and crushing the mass into a compact form. The brick is then removed from the press and set in the sun to dry, after which it is ready to be used.

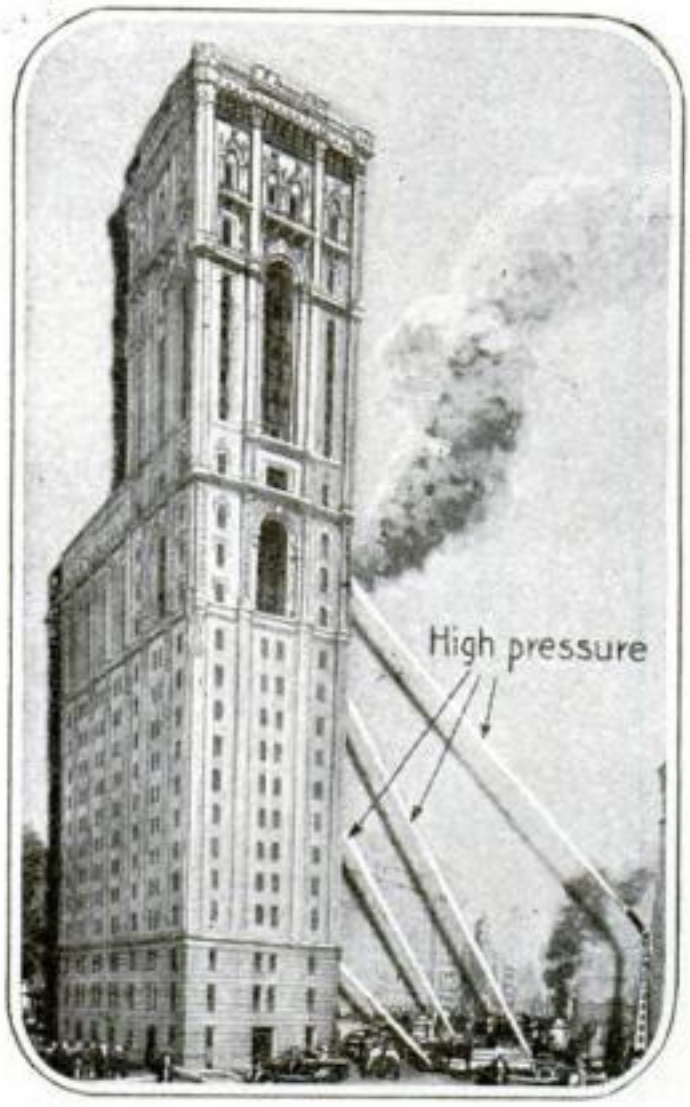
The dry paper bricks may be boiled in paraffin and used as candles in the trenches. Strips of newspaper rolled up tightly into cylindrical form and then boiled in paraffin have already given much satisfaction as trench candles. Since the bricks are larger and more compactly pressed, they will burn much longer than the paper-strip candles.

The High Pressure System Applied to the New York Fire Department

IN the accompanying photograph may be seen four streams of water being played on an imaginary fire in New York city. The stream nearest the ground is from a low pressure hydrant, the maximum pressure being only eighty pounds. The stream next above it is from a fire engine. In this case the pressure may be as high as from three hundred to four hundred and fifty pounds, which is sufficient to discharge from seven to nine hundred gallons of water a minute.

Two high pressure streams are shown, one delivered from a deck pipe and the other from a water tower. The deck pipe stream, operating at a pressure of one hundred and seventy-five pounds, delivers one thousand, five hundred and ninety gallons of water a minute. The water tower, operating at one hundred and fifty pounds, delivers one thousand, four hundred and seventeen gallons of water a minute.

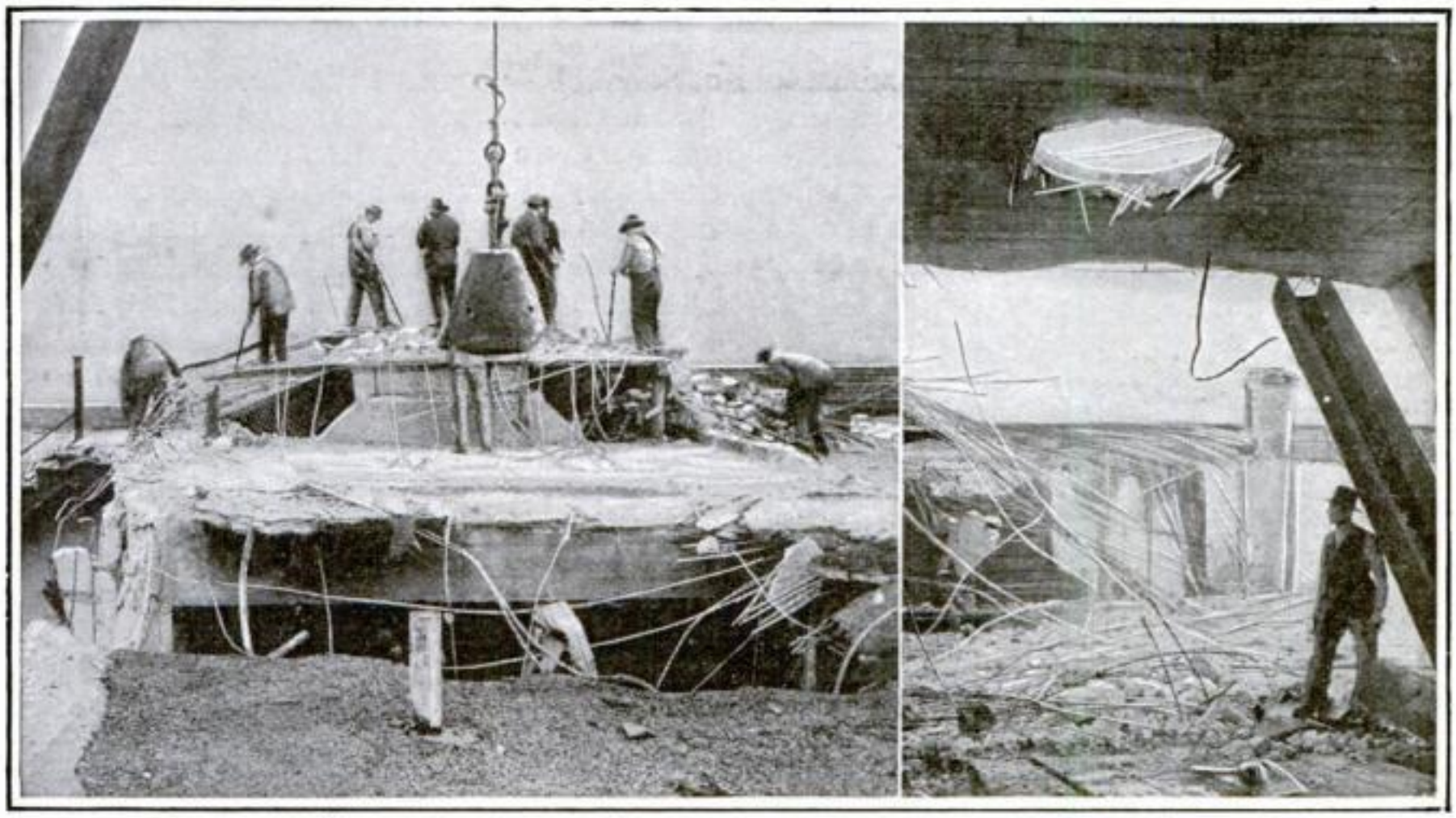
A water tower delivers water to the fifteenth floor, a deck pipe to the eighth floor, and a gasoline pumping engine has delivered working pressure at the fifty-sixth floor of the Woolworth Building. There are twenty-three hundred high pressure hydrants in New York city.



The four mighty streams of water with which New York fights fires

Pounding a Building to Pieces

How a huge iron ball was used to demolish a concrete structure



The iron ball, weighing over half a ton, is suspended on a single fall line. This implement, together with a stiff-leg derrick and a boom is mounted on a convenient movable platform. At right is shown a good sample of the device's handiwork

POUNDING a reinforced concrete building to pieces with a one-thousand-two-hundred-pound iron ball was the novel method used by a Chicago wrecking company. The building in question was an eight-story structure. It was designed to carry heavy printing machinery, and was unusually strong.

In order to save labor, the wrecking concern conceived the idea of using a cast iron ball, weighing over half a ton. The wrecking outfit, carrying the ball or "skull crusher" on a single fall line, consisted of a stiff-leg derrick and forty foot boom, mounted on a sixteen by twenty-four foot platform on rollers which were built for this particular job to facilitate the steering of the platform between the columns of the building.

In wrecking a floor the ball was dropped from a height of about forty feet on the central parts of a slab, until the concrete was shattered up to the column capitals or to the edge of the beams, after which the reinforcing bars were cut by means of an oxy-acetylene flame.

The blows of the ball were then directed over the center of the column, where they broke the concrete away from the rods at the base of the columns at the next lower floor for a height of approximately four feet. When as much as possible of the column concrete had been broken off by this method, a wood fire was maintained around the column base for eight hours. Then water was thrown on the column. This had the effect of cracking the concrete and weakening the column so that when the column reinforcement had been cut with the acetylene torch, a block and tackle attached to the electric hoist easily pulled the standing mass over. Portions of the brick walls not backed by concrete were knocked over by swinging the ball against them. After breaking all but one panel of a floor, the wrecking machine, moving under its own power, on an inclined runway, was lowered to the next floor.

Fifty Thousand Operations to Make a Car

How they are performed on the minute by means of the wonderful "Control Board"

By Reginald Trautschold, M. E.

THE automobile is now so familiar to us that we have ceased to realize how complex a machine it really is. Fifty thousand or more manufacturing operations are required on a car, and each operation must be performed at exactly the right time.

As a guide for the issuance of orders, and as a standing record of progress made in the shops, Major George D. Babcock, production manager of a great automobile company, has devised the "control board." Vertical boards are covered with a curtain of horizontal metal strips, some ten feet long and about six feet in depth. These curtains can be raised or lowered, and strips can be inserted or removed. Each strip is devoted to the graphic depiction of the progress made on some particular one of the numerous parts manufactured. There are about one hundred such strips on each control board.

The horizontal distances along the strips represent work days, so that a vertical line at the extreme right of the control boards may be taken as representing the date at which the car must be completed. A distance to the left of such a completion or zero line on any strip will then measure a definite number of work days prior to the date at which the car should be ready to leave the factory. At the proper locations on each strip are small square blocks, known as "cages," each representing a specific operation in the manufacture of a particular part. The distance of each cage from the zero line indicates the date at which work on each operation should be commenced. For instance, take the strip devoted to Part *B*, in the illustration below. This part is required thirty days before the automobile is completed, but no earlier, and, of course, no later. A cage is therefore mounted on the Part *B* strip, thirty work days to the left of the zero line, to indicate that thirty days before the car's completion Part *B* must be finished.

Two mechanical operations are required to complete Part *B*, each one of which requires a work day. A cage indicating the second operation is then mounted on the Part *B* strip to the left of the "finish" cage, separated from the latter by a space representing one working day, and another cage for the first operation is mounted the same distance to the left of the cage for the second operation. The distance between cages represents the time required for the operation immediately to the left; the space occupied by the cages themselves denotes the time allotted to examining

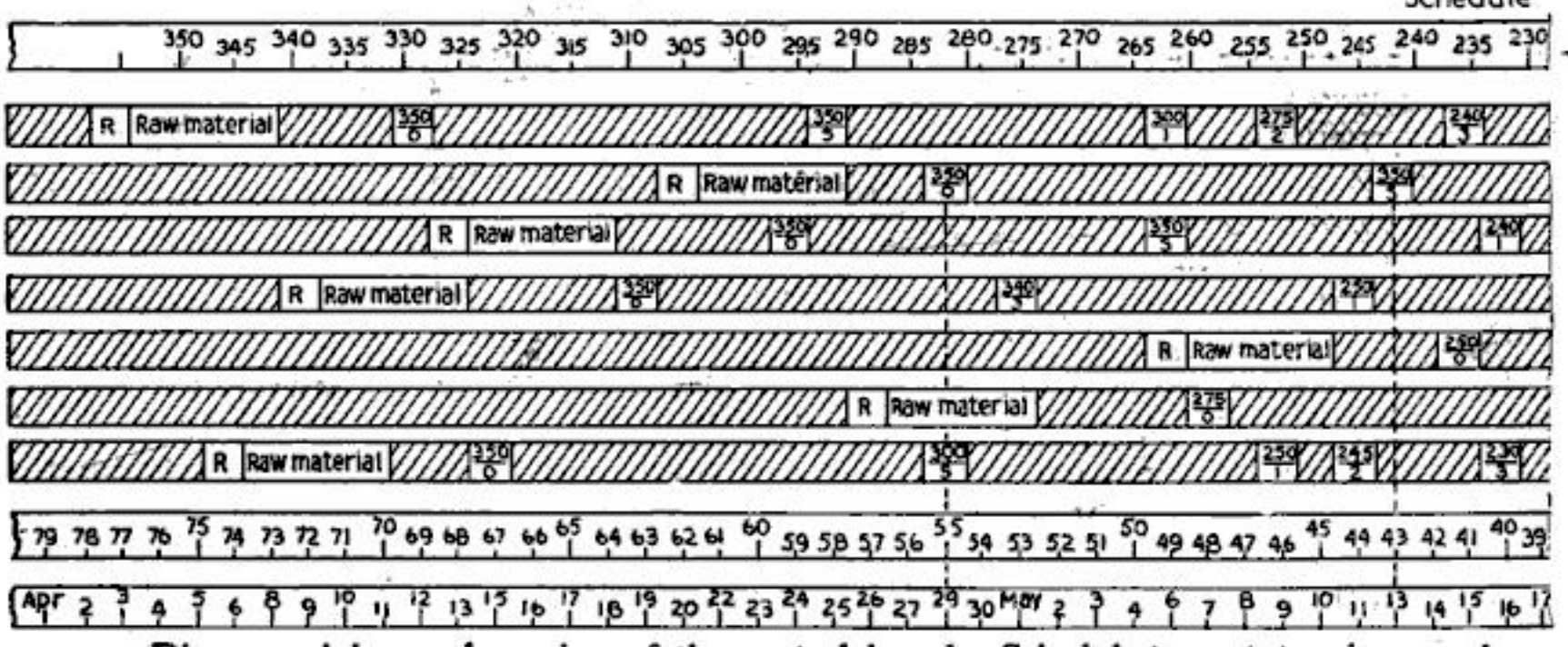
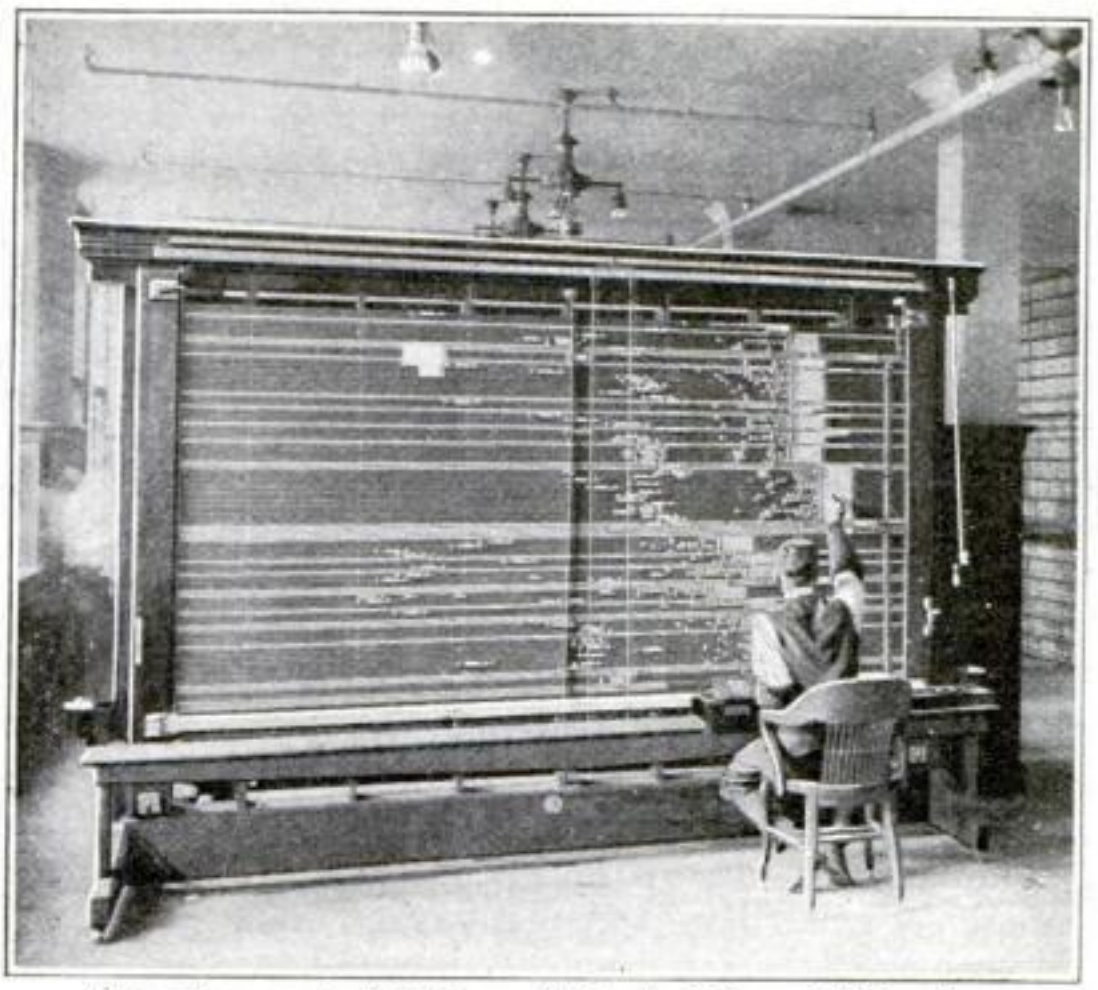


Diagram giving a close view of the control board. Schedule tape at top is moved one have been completed to date. Part A, and the other strips, show progress on the parts of

the work, and to moving it to the machine employed for the next operation.

Prior to the first operation on any part, the necessary material must, of course, be in stock, or in "stores." To guard against any possibility of failure, it is well to have the material in "stores" a few days before it will be needed, say eight days, so another cage is mounted on the strip, eight days to the left of the first operation cage. To the left of this "store" cage is an "order" cage. This "order" cage is mounted such number of days to theleft of the "store" cage as may be needed for the filling of the purchasing agent's order. A few work days to the left of this "order" cage is placed a requisition block, specifying the kind of material needed, to act as a guide for the purchasing agent so that he may make any necessary search of the market, or bargain for fair prices.

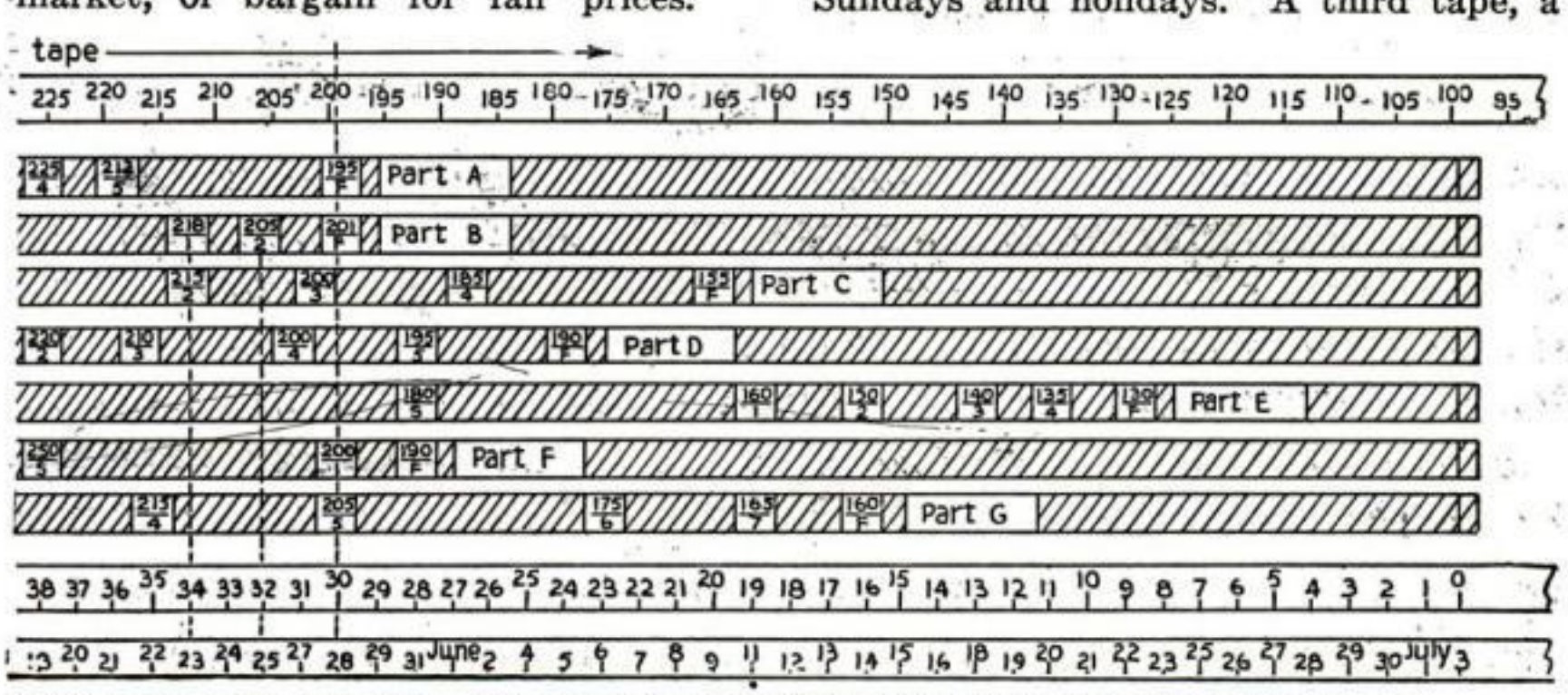


Operator seated before a "Control Board" figuring from reports the numbers he should post for the day

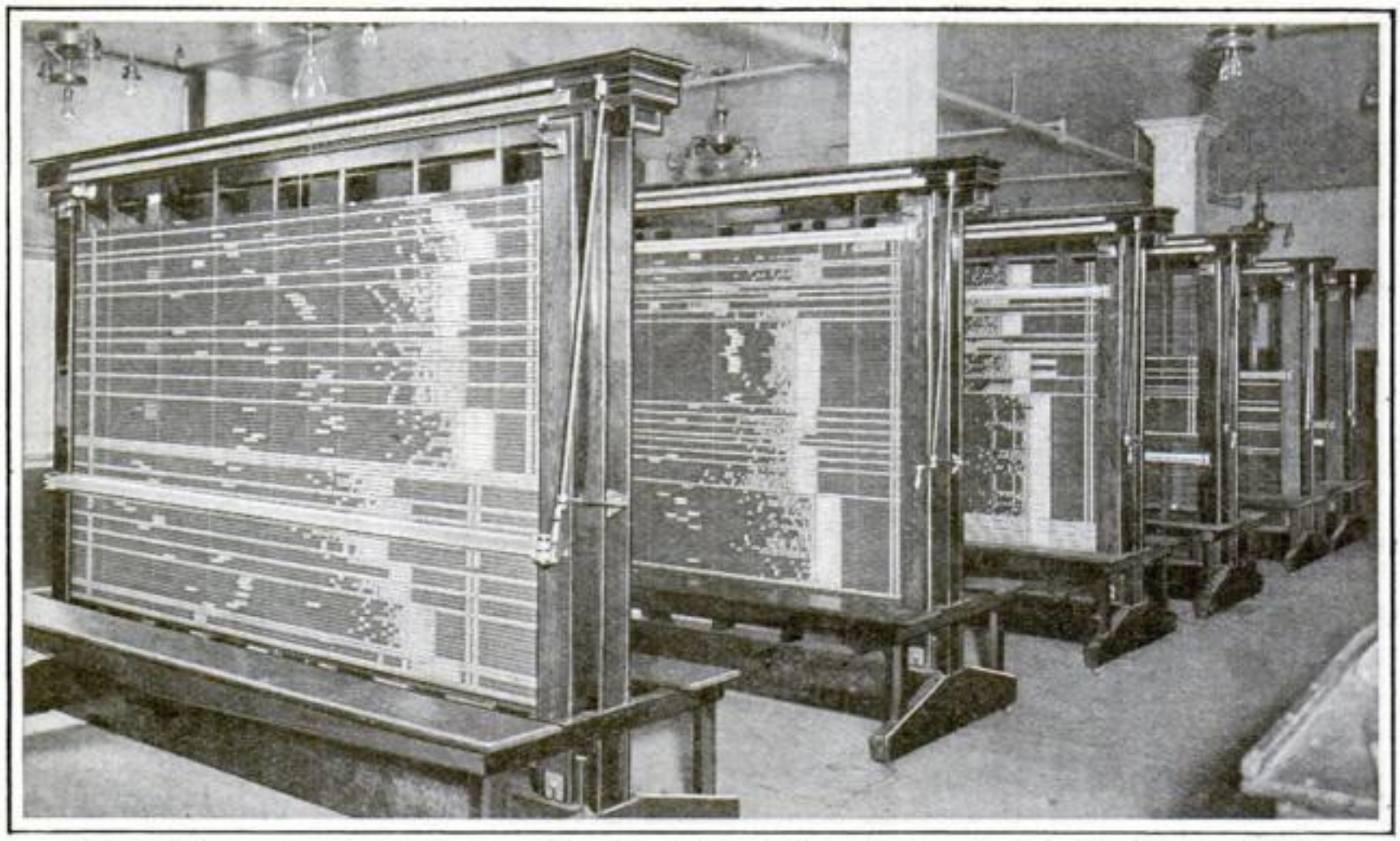
This completes the record of the required progress for Part *B*.

The requisite progress on every other part, whether a unit part or composed of several unit parts, is similarly mounted on its individual strip. This mounting of the control boards is permanent just as long as the same model of automobile is built and each strip contains full directions for all operations and acts required in the manufacture of its particular part.

Mounted so as conveniently to measure the location of the cages are two "work-day" tapes. The upper tape is divided into consecutive work-day periods and is used to measure the distance of the various cages from the zero line. The lower tape is similarly divided, but marked so as to read in calendar work-days, i. e., the days of the month, omitting Sundays and holidays. A third tape, a



division to right each day. According to the "100" at its right end, one hundred cars a car. At the bottom of the control board are metal tapes showing calendar days



"Control Boards" in actual operation in a large automobile factory. Progress on thousands of different parts is closely followed, material is provided, and the work is checked

"schedule tape," mounted at the top of the control board is provided, which in total length equals the number of work-days required to complete one car. It is divided into increments, or small divisions, representing the number of cars to be completed by the date indicated on the tape. This tape is moved one work-day division to the right, each day, so that its reading directly over the zero mark of the control boards specifies the sum total of the cars which should be completed on the particular day.

In the diagram, the schedule tape reads 100 at the zero line, indicating that one hundred of the three hundred and fifty cars in the lot should be completed on the day in which the schedule tape arrives at the position shown.

The numbers in the upper section of each operation cage indicate the progress of work on the numerous parts and are changed as reports of progress are received from the factory. For the various operations to be exactly according to schedule, the number posted in the cages should agree with the numbers on the schedule tape immediately above the individual cages. When the numbers posted in the cages are larger than the numbers on the schedule tape immediately above, it means that the progress on the part denoted by the particular cage is ahead of schedule, while when the posted number is the smaller, progress is behind schedule and the difficulty can be investigated at once before there is a serious delay.

The control board not only definitely indicates the date and size of every shop order which has to be issued, but also shows exactly what progress has been made day by day on every part entering into the mechanical construction of the automobile.

The shop management has thus a continual record and can push or retard work on any part or on any operation so as to efficiently and economically maintain schedule. In a lot of but three hundred and fifty cars, this means a reliable guide and record for as many as ten million separate operations.

The control board presupposes manufacturing under the most approved scientific methods. Photographs of it are taken frequently as permanent records of the progress, often competitive, made by the various departments.

Control boards are now being installed in one of the largest of the Government arsenals to govern and "speed up" as much as possible the production of imperatively needed munitions of war.

Stopping That Draft from Ford Pedal Slots

ON a Ford automobile, it is unpleasant in the summer to have the hot air from the engine blown up through the slots cut for the pedals and the handbrake, while in the winter, cold air coming up is uncomfortable. To remedy this little defect, remove the iron plate around the outside of the slot and place pieces of live rubber taken from a worthless inner tire, between the plate and the footboard, after which the plate is again screwed down tightly. Slots are then cut in the rubber.

Pieces of live rubber are placed between the plate and the footboard

The Champion Single-Handed Noise Producer of the World

WHEN some Philadelphia hostess invites Mr. Henry Eckert Reeves to come and entertain her guests, Mr. Reeves does not appear with only a modest roll of music. Not he! He brings with him a bass drum, a snare drum, a tambourine, a rattle, a tom-tom, a cow-bell, a steam-boat siren, a xylophone, sleigh bells, cymbals, bird calls, and various nameless but vociferous instruments such as one which imitates the roar of a cataract, or of breaking waves.

Then, using a talking machine to add the notes of the piano and of the violin to the musical mélange, Mr. Reeves gives his extraordinary one-man concert, during which he establishes a record for musical ambidexterity. Fire, flood and catastrophe are mild noise-producers compared with the agile Mr. Reeves.

This musician manipulates the most remarkable collection of instruments ever assembled for a one-man concert

Ears Rust Out More Quickly than They Wear Out

OUR recruiting officers have made an interesting discovery in gaging the relative fitness of city and country boys for service in the Army or Navy. City boys have better ears.

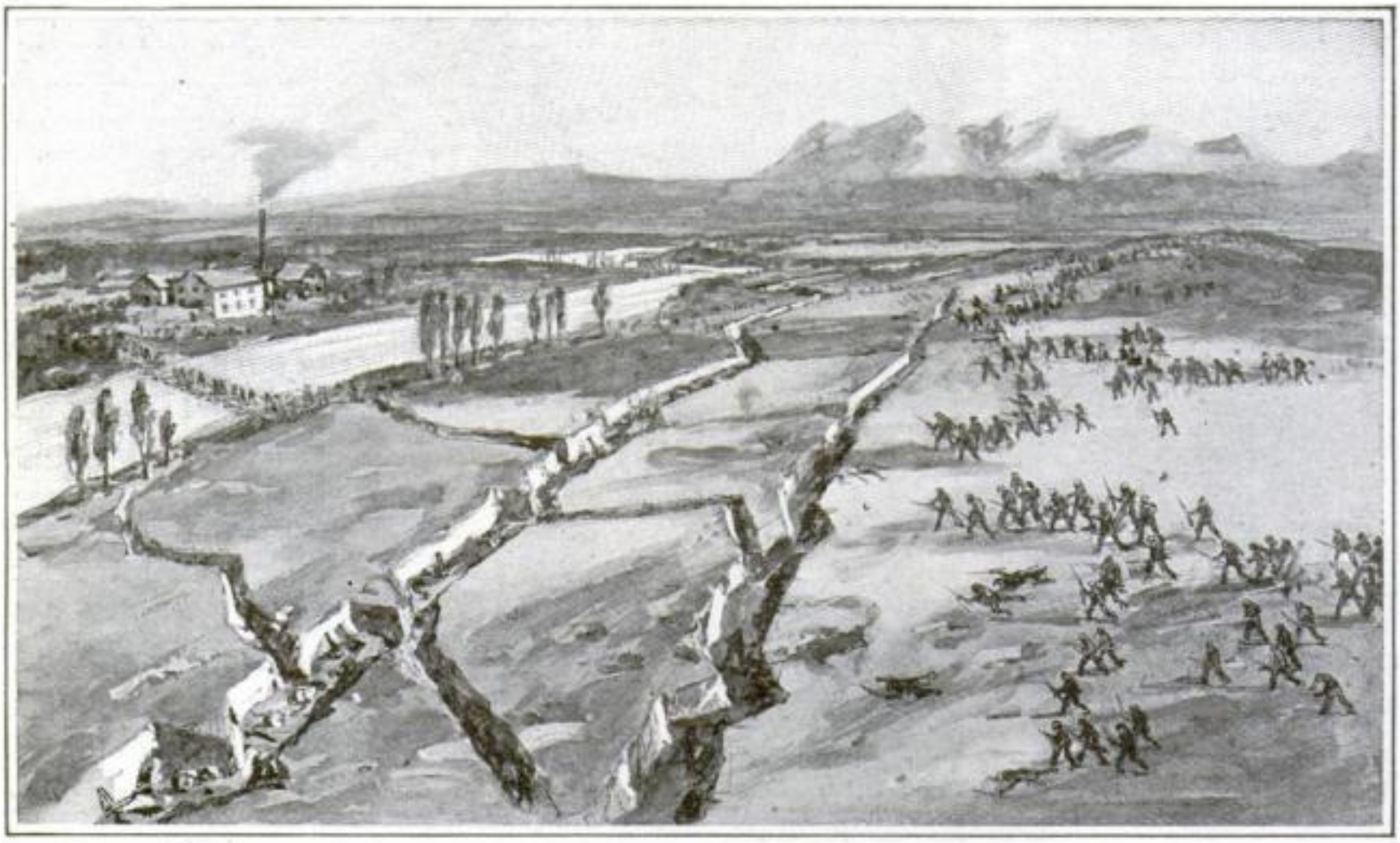
From the Washington records of the Marine Corps come the assertion that only one boy in five among those recruited in quiet neighborhoods has the acuteness of hearing possessed by the average dweller in a noisy town. The rejections on the ground of defective hearing were in the ratio of five to one in favor of "city ears."

The surgeons and scientists assume that the quiet of country districts tends to weaken, through disuse, the nerves in the ear, while the constant clamor of the city, really keeps the aural nerves responsive.

The Hell-Trench of the Piave

How an attacking German force was electrocuted as it rushed a second line of trenches

By E. T. Bronsdon

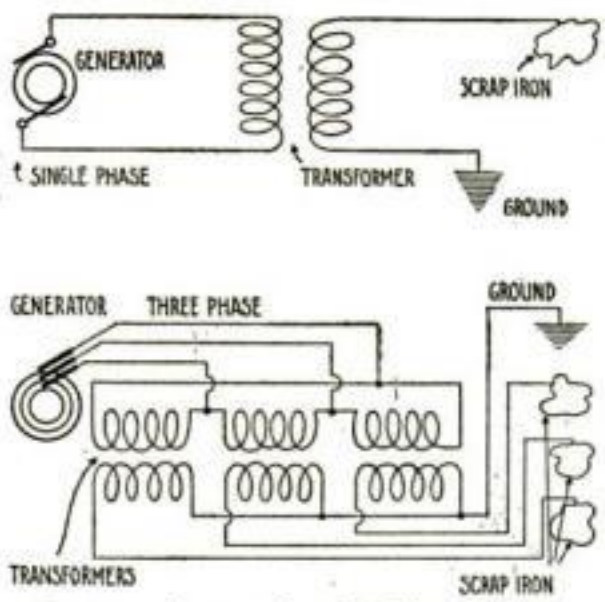


How eight thousand Germans were electrocuted near the Piave River. They rushed a trench filled with scrap-iron charged to high voltage by power plants from two adjacent towns

WHEN the Italians stopped, a few weeks ago, with their backs to the Piave River, in northern Italy, with the intent of delaying the Austro-German advance as much as possible, an incident occurred which illustrates the scientific resourcefulness of the Italians and also shows how much of a factor the unexpected can become, even in this warfare of to-day.

It was certain that no long stand could be made on that side of the river; the Teuton preponderance in men and guns was too great. Any expedient which might gain hours, however, was worth considering.

An Italian engineer by the name of Mertilli was responsible for the plan. Before the final German thrust was delivered, Mertilli caused the second-line trench to be evacuated over a front of eight miles, except by workmen.



Connections the Italians may have used. Instead of the single-phase and three-phase circuits above shown, direct current may have been available

In this second trench he placed some discarded machine guns, plates of corrugated dugout armor, and even some veteran field pieces, which seldom made an appearance in the trenches. The whole floor of the trench was lined irregularly with pieces of metal of different kinds, so that no matter where a man might step he was likely to touch one of the pieces. Then service electric cables were stretched to the trench, across the Piave, from two of the small towns just on the other side. These carried the heaviest charge of

electricity the plants were capable of turning out. The cables were connected up by concealed wires with all the bits of metal, the machine guns, the field pieces and the corrugated armor. Safety zones were left for the escape of the defenders of the first trench, but all other parts were connected with the electric cables.

The next morning the German mass attack came, driving the first trench defenders back remorselessly. The huge body of men swept over the first trench, and on to the second.

The electrical slaughter was silent and terrible. The German regiments coming up behind could not know what was wrong

Something radically wrong appeared there. Men jumped into the trench, and it appeared to be evacuated, yet the invaders did not re-appear. The charging Germans behind could not know what was wrong. They came on and on, seizing the machine guns, the old field pieces and whatever they could lay hands on. It is needless to say that none of these lived to tell the tale of their captured trophies, for each was electrocuted where he first entered the trench.

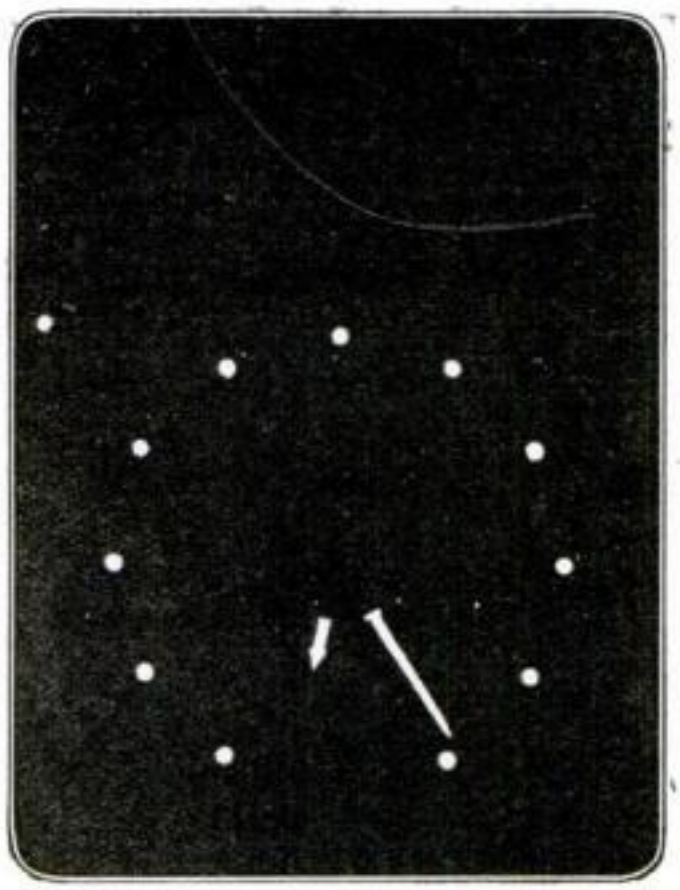
All along the eight miles, the condition was the same. Of course the German command soon found out what was wrong, but not until nearly eight thousand of the very best of Germany's troops were dead—and all without a single Italian casualty! And besides, the attack was halted for a day giving the Italians time to reorganize their defenses, on the other side of the Piave.

The Seal Which Is Used on Our Paper Money

A RELIC of the Revolutionary days when we were not yet a nation still remains on our paper money. The seal which appears on every bill issued by the Government contains the abbreviated words "Thesaur. Amer. Septent. Sigil. The full phrase is "Thesauri Americana Septentriomalis Sigillum," which simply means, "Seal of the Treasury of North America." Our distinguished ancestors felt that if a thing were to be said with dignity, it had to be said in Latin.

Don't Light a Match. Read Your Clock in the Dark

SMALL, flat disks treated with a radium compound are now being glued on the dials of clocks at the five-minute points and also to the hands so that the clock can be read in the dark. A complete set of eleven disks and a pair of hands can be affixed to a clock in a few minutes.



Disks treated with a radium compound are placed at the five-minute points and on the hands

The glow is practically everlasting and the disks, according to the manufacturer, will outlast the mechanism of the clock itself. The disk is omitted from the 6 of the clock so that the dial may be read instantly.

For automobilists, campers, hunters, doctors, nurses and soldiers this clock is a great convenience.

Loading Bullets Without a Mistake in the Weight of Powder and Shot

A RIFLE-SHELL must contain just so much powder, or else the range and accuracy of the weapon will be seriously affected. The shell casings, the bullets and the little primer caps that set off the shells are made up in large quantities and are as similar as human skill can make them.

The primer cap is inserted in the base of the shell before loading. Hence it is only necessary to load the shell casing with the necessary weight of powder, insert the bullet and clinch it firmly into position to secure uniformity in completed shells. Without mechanical aid this would mean extremely careful weighing of the powder, transferring the powder to the shell, tamping it firmly in place, inserting the bullet and, finally, clinching the end of the shell-casing about the bullet, this last operation requiring mechanical assistance. Altogether it would be a tedious task, this loading of shells by hand, and one in which there would be great likelihood of error.

To avoid such a great waste of time, the machine, here shown mounted on the well-lighted workbench, has been evolved. It is composed of adjacent cylindrical chambers mounted above a common funnel, in one of which is placed the powder supply and in the other the bullets. Oscar (the loader) has but to manipulate the lever in his right hand, first to feed just the right amount of powder into the shell placed under the loading connection just below the top of the bench, and then to feed in the bullet. By means of a foot treadle, the bullet is pressed firmly down on the powder; the casing about the bullet is clinched; and the clamping device is lowered and released so that the loaded shell may be removed by Oscar's left hand.

With this semi-automatic machine, the whole operation of loading a bullet occupies but a few seconds

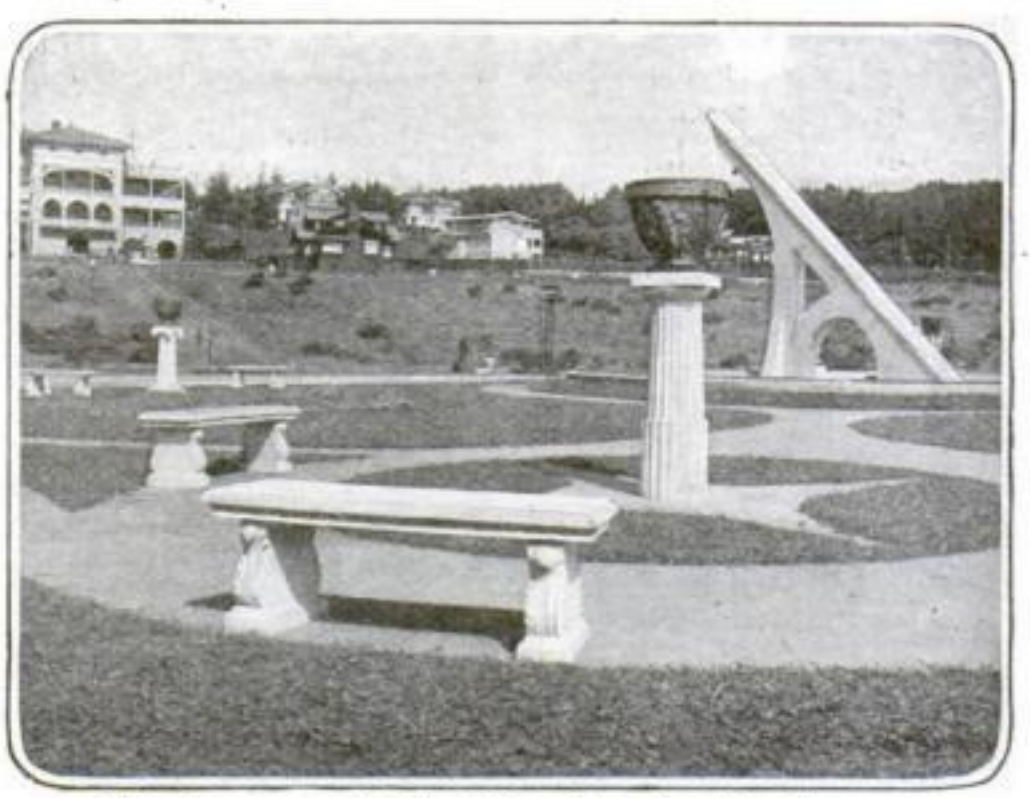
The whole operation of loading with this semi-automatic loading machine occupies but a few seconds and the work is done correctly, without possibility of error.

A Very Busy Sun Dial

"Let others tell of storm and showers
I'll only count your sunny hours."

THE mammoth sun dial which has been erected in San Francisco, by a realty company, must have a busy life because in the bright California climate, sunshine and daylight are almost synonymous terms.

In spite of all the modern timepieces available, the symbolic sun dial is enjoying an unexpected renaissance.

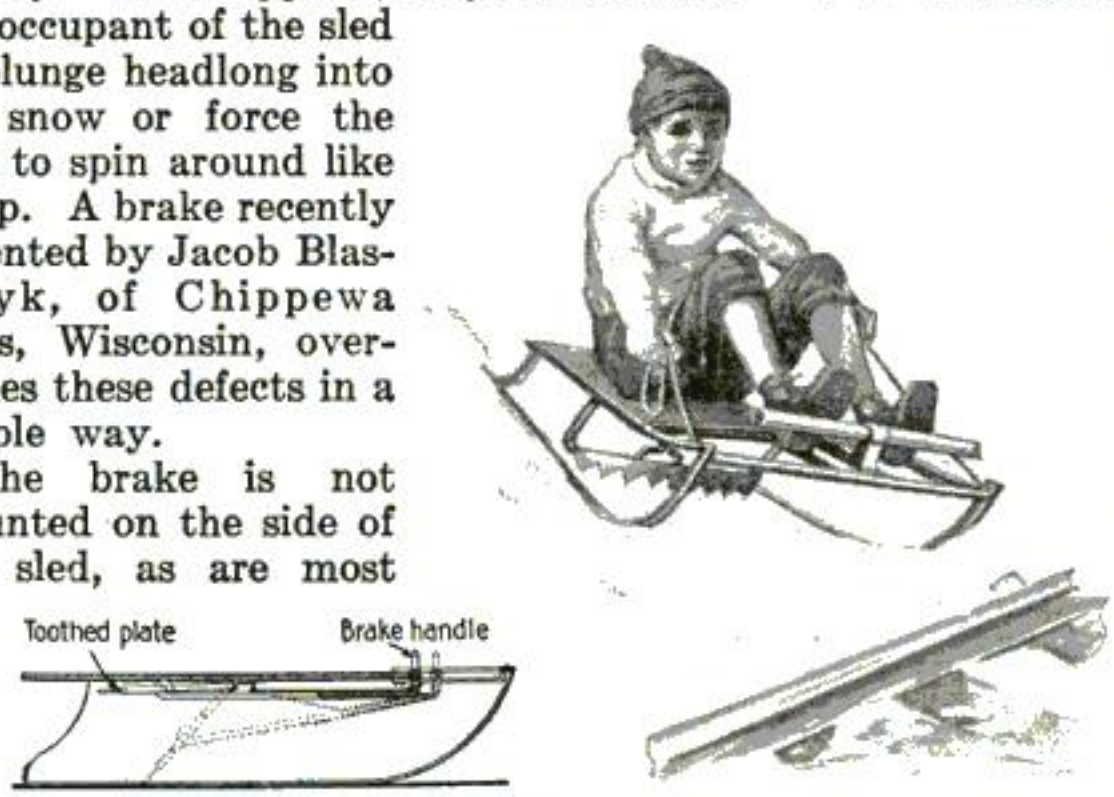


This huge sun dial is thirty-four feet in diameter

A Sled Brake Which Will Not Throw You Headlong Into the Snow

SLED brakes seldom work satisfactorily. When applied, they either cause the occupant of the sled to plunge headlong into the snow or force the sled to spin around like a top. A brake recently invented by Jacob Blaszczyk, of Chippewa Falls, Wisconsin, overcomes these defects in a simple way.

The brake is not mounted on the side of the sled, as are most boy-made brakes, but is rigidly attached to the underside of the sled top. The brake end consists of a toothed steel plate, which is made fast, by means of a rod and strong spring, to a handle at the front of the sled. To operate the brake, the handle is pushed forward on anti-friction rollers which travel between wooden guides. This is done with the rider's feet, as he sits upright on the sled.



To operate the brake, a handle which moves between wooden guides is pushed forward on anti-friction rollers

Cook a Breakfast for Six for One-fourth of a Cent

TO-DAY the question of fuel is a burning one, metaphorically as well as literally. In a series of very interesting tests recently conducted at the Ohio State University, natural gas was found to be the cheapest combustible. There are many places, however, where it is not available.

A breakfast which cost one-fourth of a cent to cook with natural gas, cost nearly three and one-half cents to cook with soft coal, two and one-half cents with coal oil, over three cents with gasoline and three cents exactly with electricity.

How Many Motion-Picture Tree-Top "Close Ups" Are Taken

WHENEVER you are puzzled by the unusual in motion pictures, there are always two points to be kept in mind. The scenes are not taken in the order in which they appear on the screen, and continuity of thought takes the place of continuity in fact.

For instance, if you see a girl start to climb a tree and an instant later see her in the topmost branches, the thought is practically continuous and your mind imagines the rest of the climb. The accompanying photograph shows how such a picture was actually filmed. All of the scenes on the ground, before and after the heroine was supposed to have climbed the tree, were taken first. Then strips of planking were nailed to the tree and the tree-top "close ups" were taken.

The camera platform is mounted on a motor truck. Ground props prevent all vibration

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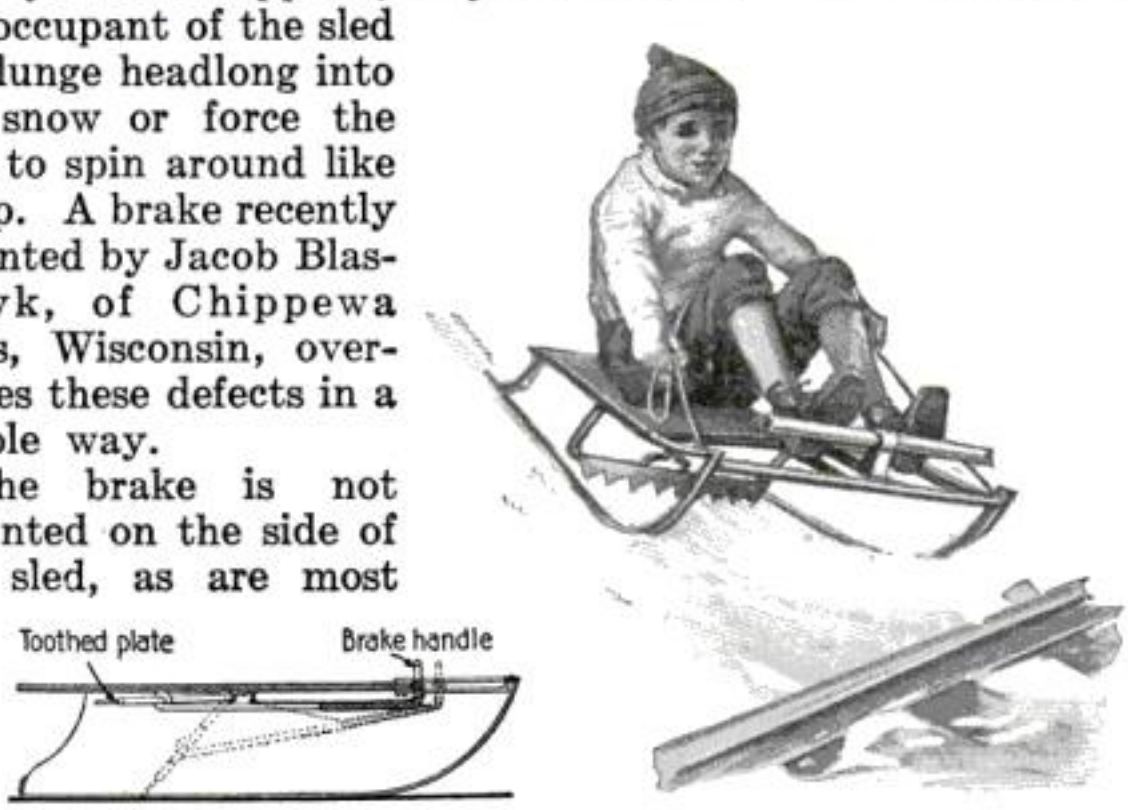

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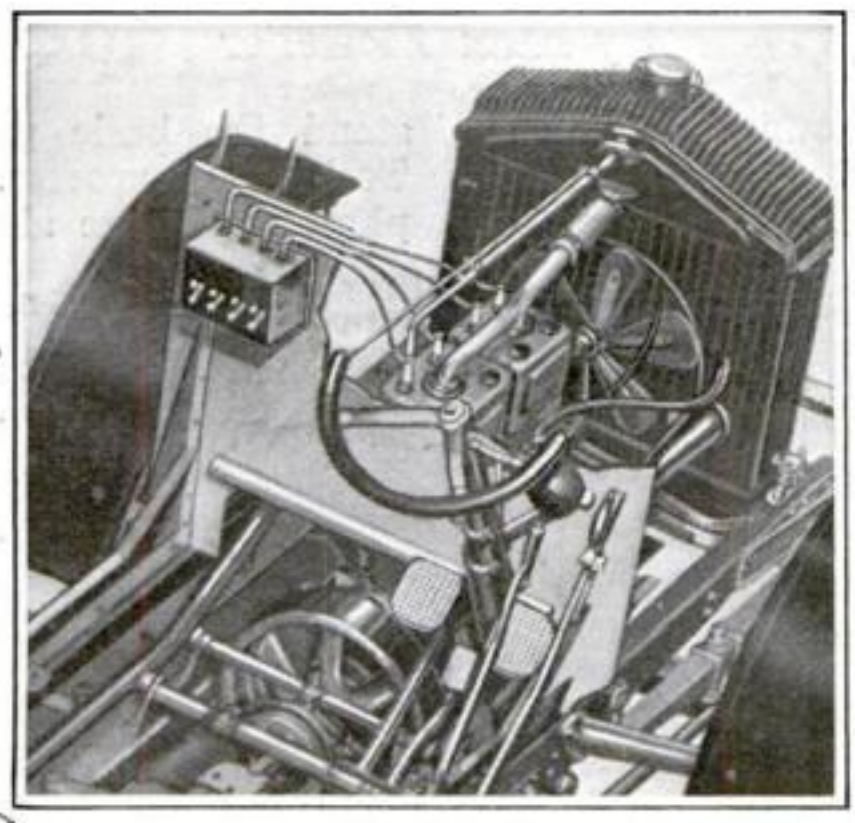
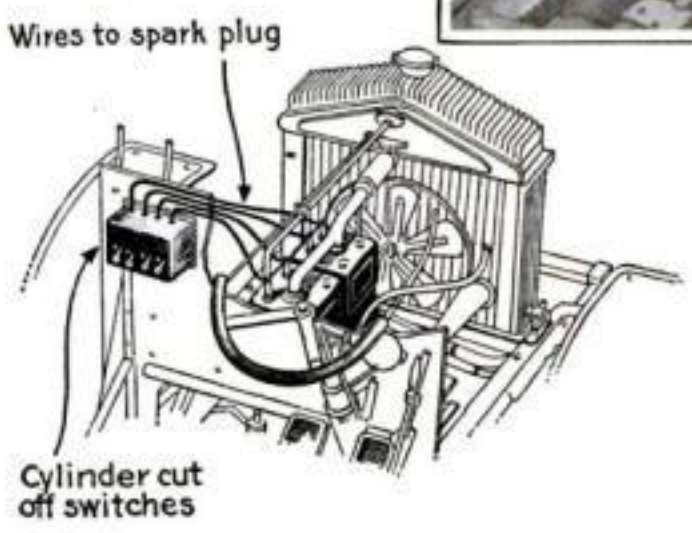
Which Cylinder Is Missing Fire? Find Out from the Seat

THE invention shown in the accompanying illustration can be used either as a testing apparatus for shop work or as a permanent device to be placed on the dash of an automobile. The chauffeur can determine easily and quickly just which one of his engine cylinders is missing fire without getting out of his seat or raising the hood over the engine. The offending cylinder is detected by shutting off the ignition circuit of all the cylinders except one and allowing this one to pull the others against compression. To shut off the circuits, little contact plugs on the front of a box on the dashboard are depressed by means of small handles which force any particular strip back against a bus bar at the rear. When this is done, the current is shunted from the plug through the lead and bus bar back to the current source through the usual ground wire. Naturally, if a particular cylinder is not firing properly, its power will not be sufficient to carry all the pistons over and against the combined compressions. Therefore, by allowing the current to pass through each spark plug, if necessary, the offending one can soon be located. If the cylinder is firing, as it should, the engine will run without help from the other cylinders.





Showing the mechanism of the ignition-detector. Using it, the chauffeur can test his cylinders without getting out of the car

Mandolin Music Via the Tuneful Molar

AT last someone has discovered what has ailed the mandolin these many years. With his trained architectural eye and his well-developed sense of what's what in ornamental designing, R. C. Petty, of Drumright, Oklahoma, has decided that the vitals of the instrument are in good order but the general contour of the thing is all wrong. Accordingly, he has invented an instrument which for beauty of line and lavishness of design is without a peer.

Exhibiting a marked degree of originality, he has chosen the human tooth for his model. Look at the accompanying illustration and you will see how faithfully this knight of the strings has followed the graceful outlines of the molar. But he has taken away none of the entrancing melodic quality of the instrument itself. In its new and more beautiful shape, the mandolin may be said to be even more tuneful, if such a thing is possible.

New mandolin design promises to make the human tooth famous

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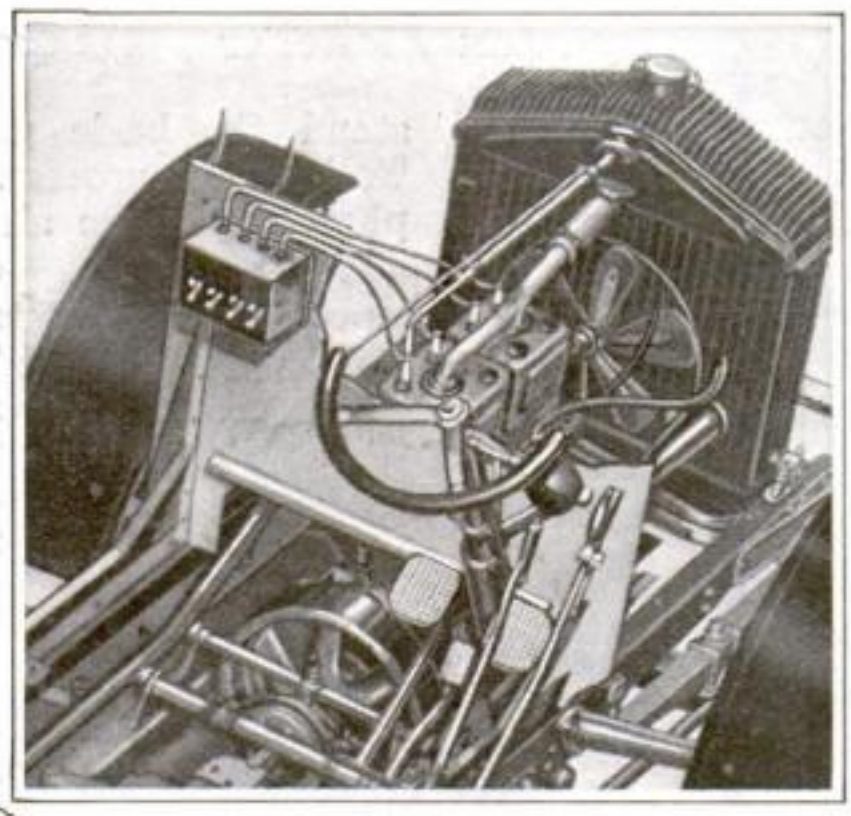

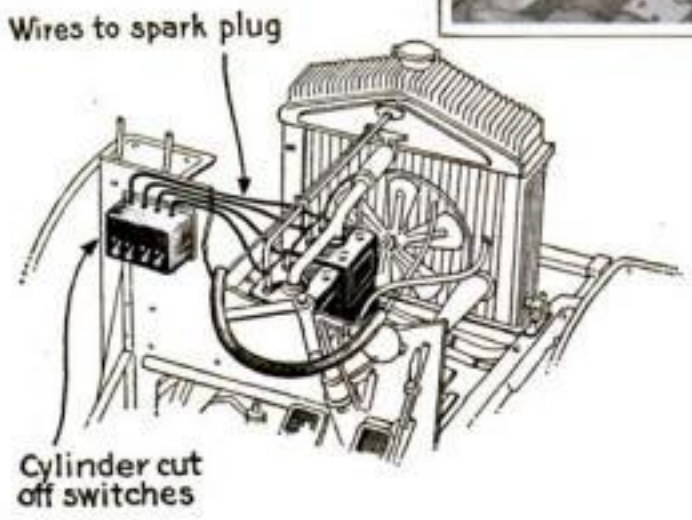

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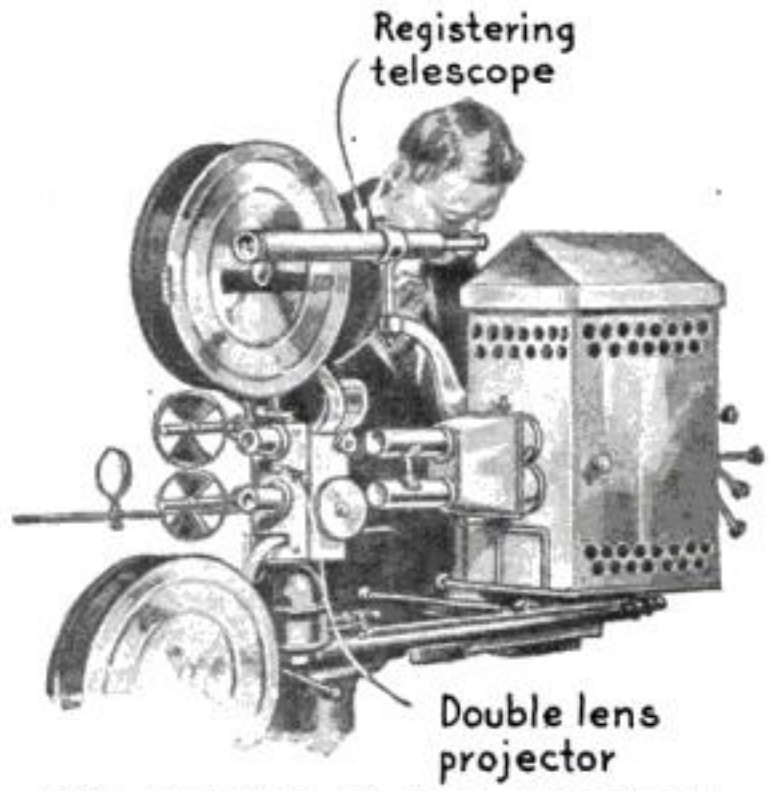
reflected by the silver; the other passes through the transparent openings.

The film which is made by this process when it is projected is not a succession of blue and green pictures. The pictures are black and white. They represent, however, the red and blue color qualities of the original object photographed. Why, then, do they appear in colors on the screen?

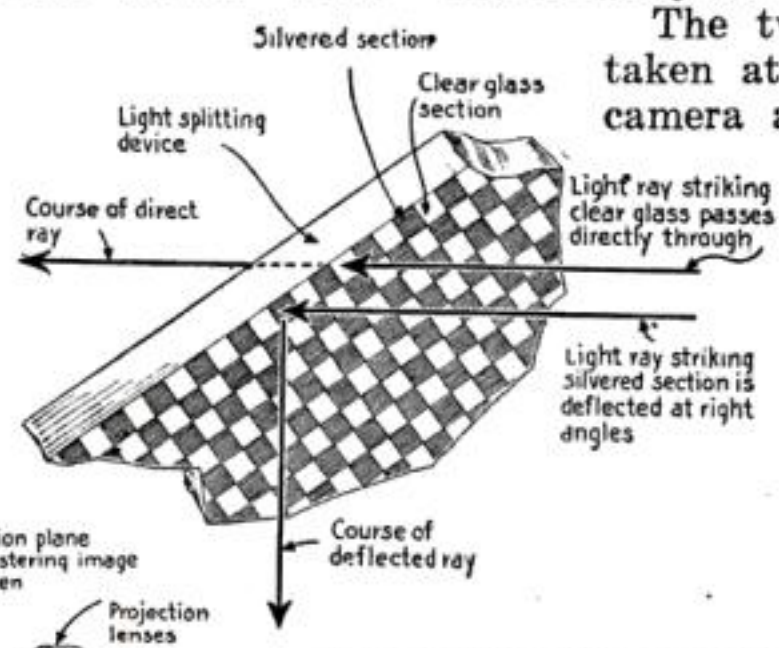
Study the accompanying picture of the projector and the answer is plain. The projector required is fitted with two lenses spaced two pictures apart. The upper lens is provided with a green-blue screen through which the images representing the red shades on the film are projected; the lower lens is provided with a violet-red screen which supplies the blue sensation. These two colors appear at the same time on the screen, one over the other. The two colors are accurately registered on the screen chiefly by observation of the general effect produced. However, it is not necessary for the operator to rely entirely on his judgment to secure registration. In one corner of each red film is a minute circle, and in the corresponding corner of each blue film is a very small solid circular spot. The operator shifts the pictures so that the solid spot on one film is centered within the circle of the corresponding film. These registration marks are so small that they cannot be detected on the screen. They are located by means of a microscope permanently attached to the projection machine. The images are shifted by an additional lens to avoid the distortion resulting when the entire main line system is shifted.



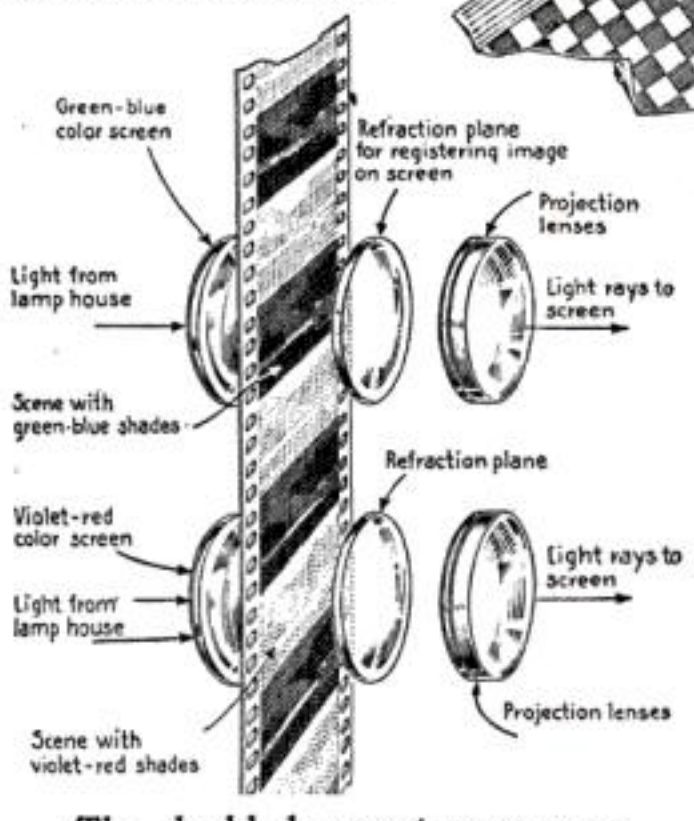
The operator of the projector is looking through a microscope in order to make the two sets of exposures register accurately on the screen

The two pictures which were taken at the same time by the camera are projected simultaneously, so that colors are actually mixed on the screen, but by a process akin to that which is used in making the colored covers on the POPULAR SCIENCE MONTHLY and other magazines.

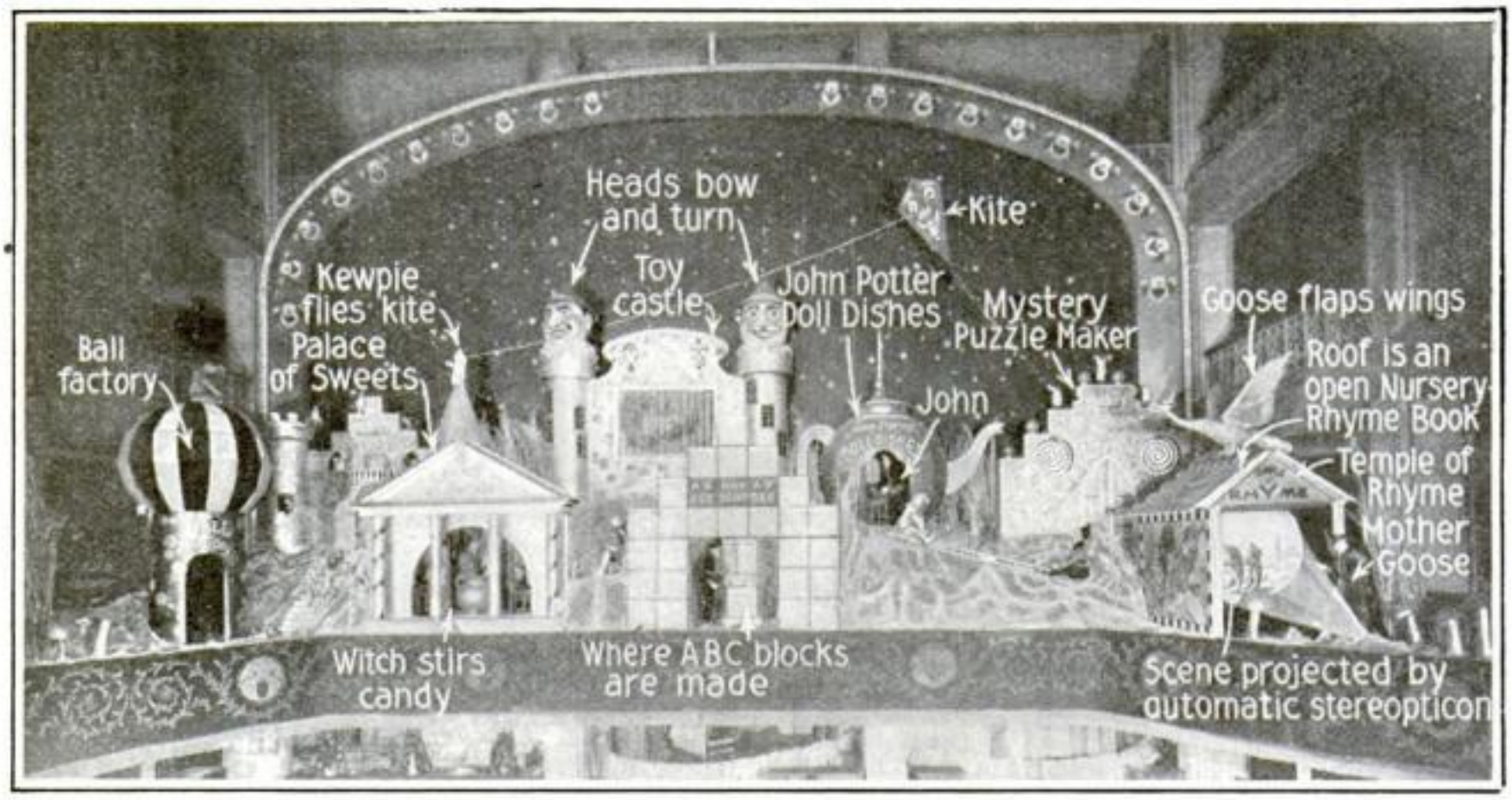
It is true that double the film length used in ordinary motion picture work is required. On the other hand, the rate of speed is that ordinarily adopted. The pictures are advanced, two at each shift, and sixteen two-color pictures are displayed every second on the screen, which is the average speed of all ordinary motion picture projections.



The light-splitting device consists of a glass plate part of which is silvered and part of which is transparent, producing a checkerboard effect. Some of the rays are reflected by the silvered portions and others pass through the transparent portions. The reflected rays strike certain parts of the film to produce one set of exposures, and also the transmitted rays strike other parts to produce the second set of exposures



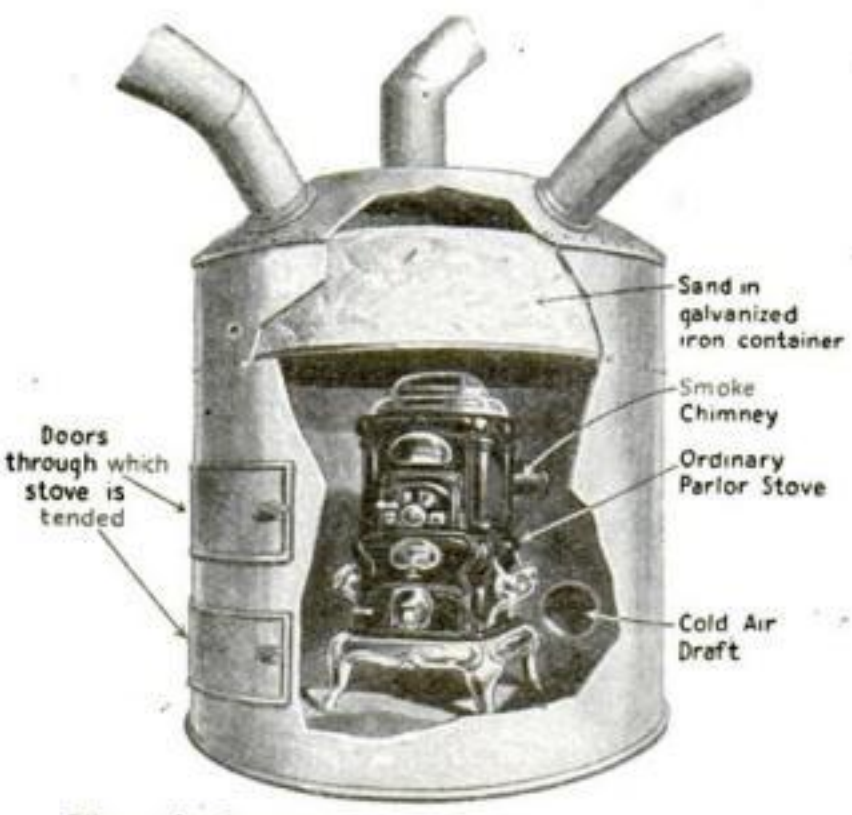
The double lens system co-operates with the doubly exposed film to secure natural effects



This colorful display of mechanical toys filled the whole side of the court of a department store. It held crowds of delighted children spell-bound each day for weeks

Mother Goose, John Potter, and All the Rest Attended Toy Town Show

WHERE is the mysterious land from which all toys come? New York cnildren recently had an opportunity to look at it. A large department store put on a display showing all the characters childhood knows well, actually at work. Balls revolved, heads bobbed, "teeter-totters" see-sawed, a goose flapped its wings; everywhere was action enough to catch and hold the entire attention of the crowds of delighted children. The panorama was designed by W. F. Larkin of the store's force, and nearly four months' work was involved in its production. All the figures were mechanically operated by a four-horsepower electric motor.



Here the inventor has placed a parlor stove inside the shell of a furnace. The idea seems to work well. The sand is just as useful in an ordinary furnace

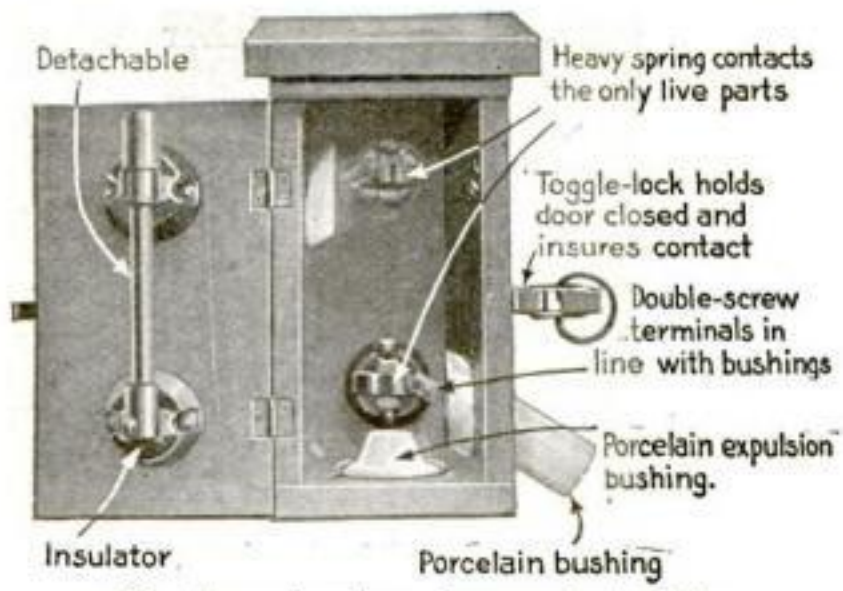
A New Cure for the Capers of Hot-Air Furnaces

FREDERICK E. JENKS of New Haven remedies the ills of the hot air furnace by placing a large tank of sand inside its top, and by using an ordinary coal stove for producing heat. The sand absorbs heat when the stove is hot and then radiates it uniformly after the fire in the stove has died down and the heat is needed.

Using stove furnace, a hod of coal keeps cottage warm twelve hours in zero weather

Removing a Fuse from the High-Tension Mains without Shock

MANY a lineman who has not taken the trouble to put on his rubber gloves has been severely burned while renewing a fuse that has "blown." A new "safety-first" fuse box, however, makes it possible for the most careless lineman to perform his task in safety.



The fuse simply swings out with the door, safely away from the dangerous spring contacts which are "alive"

The fuse proper is clipped on the cover of the fuse box. When the lineman opens the door, therefore, the fuse swings back with the cover and automatically disconnects itself from the dangerous spring contacts on the back of the box. The inspector removes the defective fuse and puts a good one in its place without going near those "live" spring contacts. The fuse and its parts are very similar to those ordinarily used and are operated automatically without opportunity to produce a shock.

A Bridge Built on a Single Line of Posts

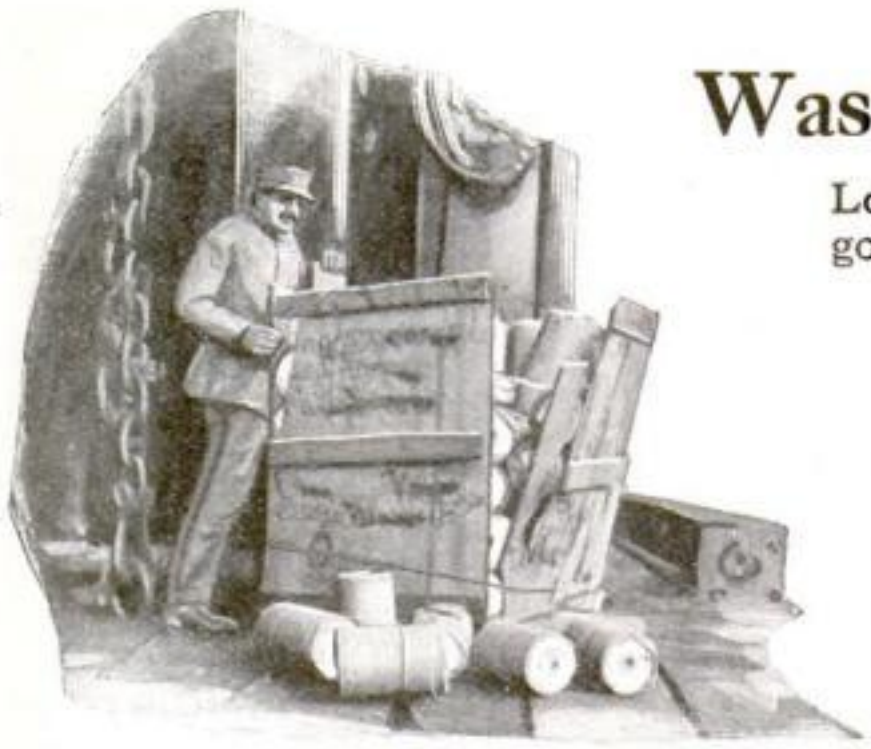
IF you have ever crossed a country bridge which swayed and creaked ominously underfoot when the wind was high, and which looked as if the weight of the village "fat man" would be more than it could bear, it will not come as much of a surprise to learn that many bridges of this type are very hastily constructed. The one shown in the illustration took all of one whole day to build.

The novel point in the construction shown is that it rests on only one set of posts, which are set like a row of telephone poles, only nine feet apart. Each pole is supported by two braces, one on either side, and each has a cap on top. The walk boards are long and narrow. One board covers the distance, in length, between three posts.

This bridge, which is thirty-four feet from the ground, is built on only one line of posts. Each pole is supported by two braces, one on either side and each has a cap on top

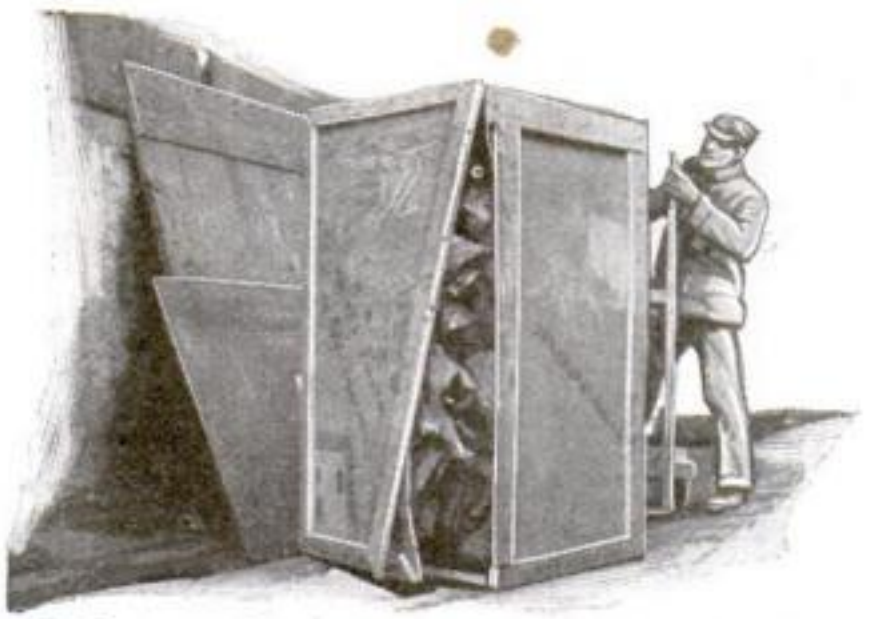
Wasting Two Millions

Loss awaits the shipper who packs goods neither wisely nor well



This second-hand box gave up when it was called upon to carry heavy rolls of cotton warp

BEFORE the war, the loss and damage to merchandise on a single Eastern railroad cost more than a million dollars a year! This year it will reach two million dollars—a year in which the Nation is supposed to act as a unit in the prevention of waste. What is the reason? Simply foolish economy. Shippers are using cheap packing materials and weak or second-hand containers.



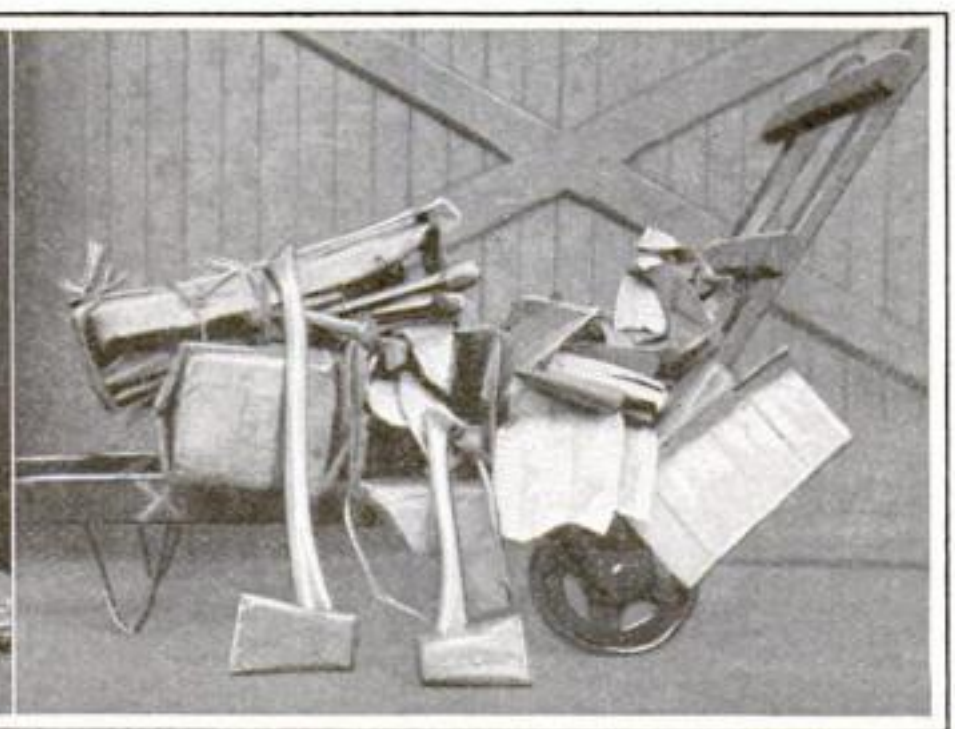
Is it a wonder the heavy bolts of cloth broke through this insecure, flimsy packing box?

Such a waste, says the Pennsylvania Railroad, is indefensible. The only way to avoid it is to pack goods properly in strong containers and to mark them plainly, all old marks having been previously removed. Co-operation is also asked of receiving clerks, agents, foremen, car inspectors, loaders, truckers and car packers, that the waste may be eliminated at once.

Axes have been discovered shipped in paper boxes, potatoes and onions in flimsy crates, dangerous solutions in leaky barrels and food stuffs in second-hand containers of paper. In one instance, a shipment weighing nearly fifteen hundred pounds was packed in a second-hand box made of one-half inch lumber. It fell to pieces *en route*. Other instances of careless packing are shown in the photographs.

Obviously cheap containers lose a shipper more than he saves. Worse than the mere

Iron castings bulge out of thin gunny-sacks at a wayside station



Pack axes in paper boxes and this is what happens

damage to his product, or its total loss, is the ill feeling on the part of the customer that is engendered. When a man has been waiting long and anxiously for needed goods, to have them arrive all broken up and useless, simply because the shipper was too lazy, or too economical, to properly box them, naturally results in strained relations.

Crates of onions and barrels of potatoes broken in transit; the light lumber could not stand the weight

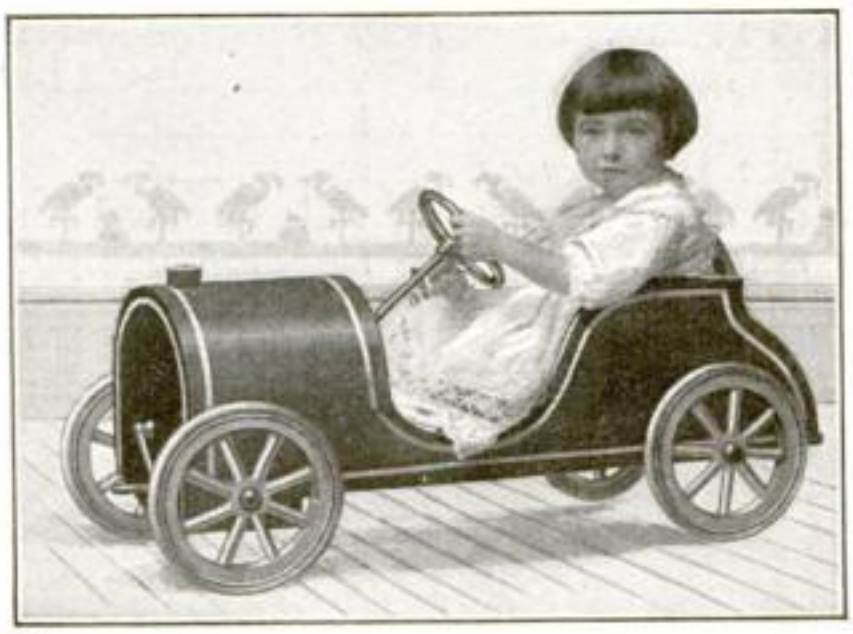
A Spring-Driven Automobile for the Youngsters. It Runs Just Like Dad's

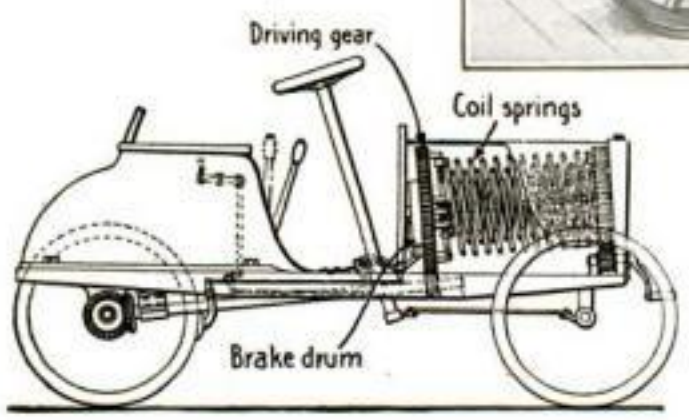
HERMANN F. CUNTZ, an engineer who has been connected with the automobile industry from its very inception, has invented a mechanically-driven toy automobile which ought to please a youngster who wants playthings that resemble as closely as possible the machines of every-day life. Mr. Cuntz has developed a machine with spring power, controlled like a real, full-sized automobile.

The little "chauffeur" on cranking this automobile, winds up a set of six strong springs. A band brake locks the springs, so that the automobile cannot run away. When the young driver takes his seat, a brake lever attached to the seat cushion is operated. The lever releases a brake band from the brake drum so that the automobile is ready to start off just as soon as pressure is put upon the starting pedal. Pressure upon this pedal loosens a second brake band and allows the springs to turn the rear driving wheels by means of the transmission gearing. Then off Johnny goes for his drive!

The motor is sufficiently powerful to carry the automobile a distance of fifteen hundred feet. Nevertheless, the automobile is perfectly safe for a child. Should Johnny stand up carelessly, a spring returns the lever attached to the seat cushion, and the motor is stopped by the brake. Moreover, the speed limit can never be exceeded, since the driving gear is so arranged that even when the powerful springs are fully wound, only a nominal speed will be attained.

Another interesting feature of the automobile is a lever attachment which enables the motor to be thrown out of gear. This makes it possible to coast down a hill and thus save power.





The nest of six springs can drive the automobile a distance of fifteen hundred feet. The controlling levers are operated just like those on gasoline automobiles. Baby has a delightful ride

Giving France the Locomotives She Needs

Six hundred and eighty engines and six thousand cars are ordered for France

A locomotive of American design, intended for service in France. The French tracks, however, require smaller and lighter engines than those with which we are familiar

WITHOUT an adequate system of railways to move troops and supplies to the front and distribute ammunition to the big batteries on the firing line, fighting, as it is done nowadays, would be an impossibility. Germany has made the world marvel at her railway system. Over night she has moved vast quantities of troops from one front to another. Never before has the necessity of rapid railway transportation been so imperative as in this present war.

France, of all the Allies, is the nation most in need of railways just now. Shortly after this country declared war, the Government placed orders for six hundred and eighty engines and six thousand cars, all of them to be used behind the battle line in France. Twenty days after the order was placed, an engine and a car were ready for shipment. The accompanying photographs show two designs of engines which are being sent abroad in very large numbers.

Since French tracks will not stand the weight and length of standard American rolling stock, the engines are much lighter and smaller than those we usually see in this country. They are of the type of 1866, but the design closely follows modern American practice, with the exception that the couplings and buffers are made to suit French standards. Designed to make long runs and to handle heavy supply and troop trains, these engines can traverse the short curves of French roads and run on rough tracks. A piping system is placed at each end of the locomotive to wash the rails with streams of hot water and steam when they are covered with mud. Another departure is a water-lifting valve by means of which the tender tank can be filled from streams or ponds alongside the track.

In addition to the large and small locomotives already made for foreign service, the Government has placed an order for gasoline locomotives. All railway equipment sent from this country will be painted battleship gray to make it inconspicuous. American motor trucks and trailers equipped with flanged wheels will be used in connection with the standard equipment. It is understood that five engineer regiments will take charge of railroad operations for the army.

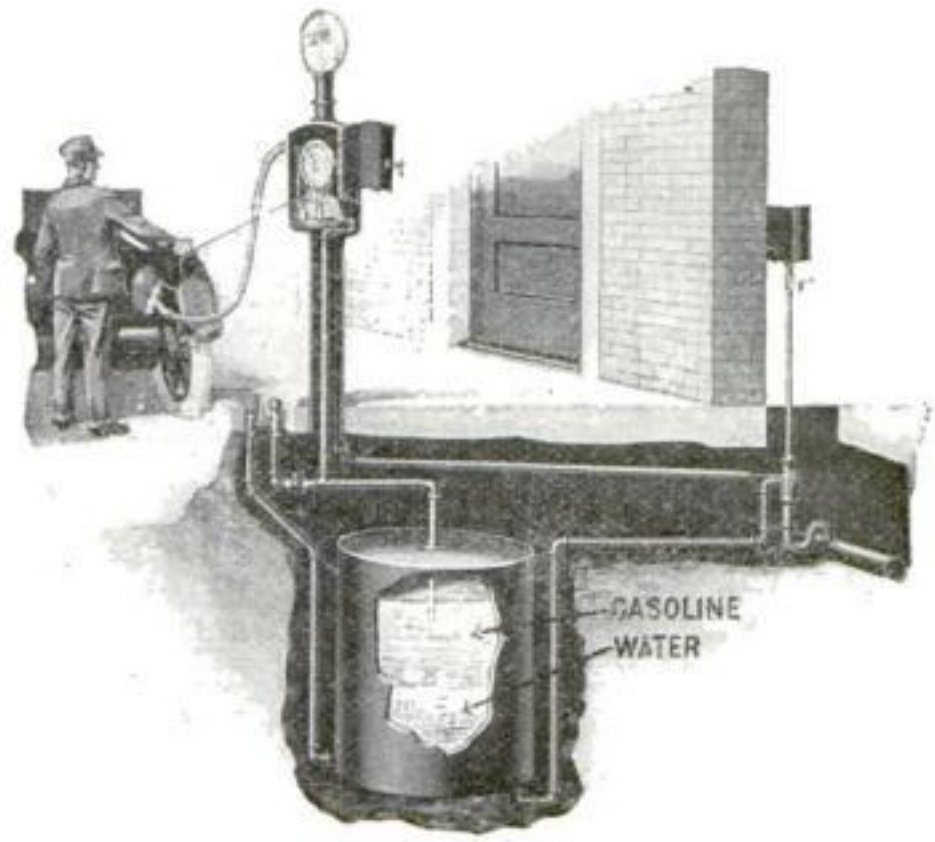
Smaller locomotives adapted to rough trackage and sharp curves such as are met with in the hasty construction of war time

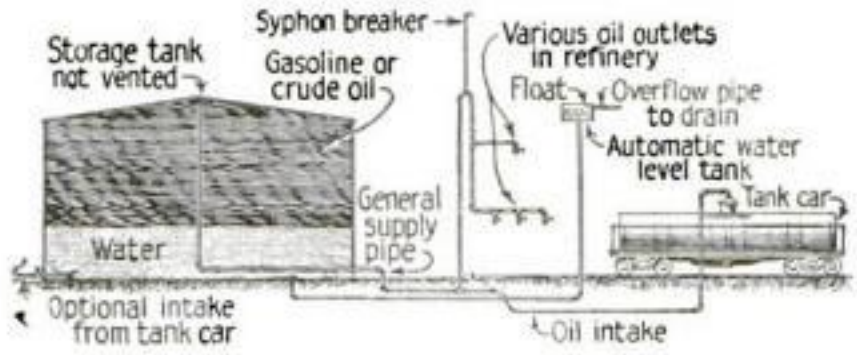
The big locomotive works the country over are loaded down with orders. France can be assured of efficient aid from America as far as locomotives go.

Conserve Your Gasoline—By Pouring Water Into It

IN spite of the fact that gasoline is becoming so scarce, until lately refiners have paid but little attention to the immense amount they lose through evaporation from storage tanks. At "tank farms," as they are called, it is not uncommon to see a fog over the tops of the tanks due to gases escaping from vents. Usually the best grade of gasoline escapes, which, if it were recovered, could be used to enrich many gallons of ordinary kinds. Vacuum systems to recover this gas have been tried, but as a rule prove expensive and not very practical.

Now comes Frederick G. Farr, of Detroit—where they use lots of gasoline—with a system designed to prevent all this waste. He would fill all space in. gasoline and crude oil tanks with water. Oil and water do not mix, of course—and water always assumes the lower level. Thus the oil is always pushed up against the top of the tank where it may be drawn off. Should gases form, they do not burst the tank—but their pressure simply pushes on the water, causing it to overflow through an "automatic water level tank" into a drain. When some of the oil is drawn off, water takes its place from this tank, a suitable float valve permitting more to enter from the plant water system, or other source.





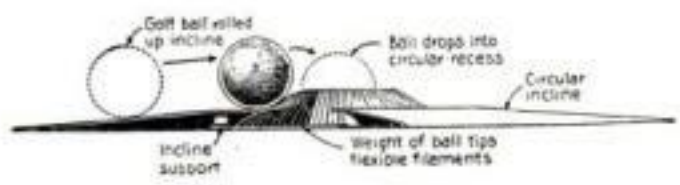
Above, Farr system applied to a garage gasoline reservoir. At left it is controlling a much larger supply tank

You Can Now Practice Putting In Your Own Parlor

DURING stormy weather, or in the winter, it will no longer be necessary for the golfer to forego his putting practice.

Eugene McLean Long, of New York, has invented a device for catching and holding a ball in such a manner that when you use it you almost imagine you are on a putting green instead of on the parlor floor.

The indoor putting green is a circular device having a recess in the center. The recess is surrounded by flexible filaments which tip when struck like blades of grass. The underlying idea is to reproduce outdoor conditions as closely as possible.



Around the recess are flexible bristle or cardboard filaments which counterfeit the action of grass

Canopus—A Mighty Celestial Furnace

It is so far away that we see it by the light that left it in the 15th century, and it is 139 times bigger than our Sun

By Scriven Bolton, F. R. A. S., M. B. A. A.

IF we took up our abode at a distance equal to one of the nearest stars, say Alpha Centauri, long before arriving there our world would be totally invisible, even if we carried with us a powerful telescope. The ratio which it bears to the visible universe of stars is inconceivably less than that which a single drop of water bears to all the oceans of the world united.

The immensity of the stellar universe will never be comprehended by our finite intelligence. Let us, however, contemplate the intervals of time required for light to bridge the awful gulfs of space around us. Traveling at the rate of at least 188,000 miles per second, light takes four years to reach us from the nearest bright star. Yet the velocity of that light is sufficient to circuit the earth at the equator no less than seven and a half times in a single second. The light from many stars occupies hundreds and even thousands of years in the journey; hence we gaze upon them to-day as they were centuries ago, and if at the present moment they ceased to shine, our senses would remain unnotified of the fact till centuries hence. Further, it has recently been ascertained that stars in the Magellanic star cloud are so very distant that their light requires 30,000 years to reach us! A striking witness to the inconceivable dimensions of what may be termed a microscopic corner of the heavens was forthcoming in 1901, when the new star Nova Persei suddenly burst forth. The rays of light thus propagated took many months in reaching and finally illuminating the nebulous region situated "locally" one might say.

The question of the size of different bodies poised in this infinite space is one which frequently arises, and the slumbering sense is startled on learning of the existence of spheres hundreds, thousands, millions of times larger than our globe. Situated as we are near the center of the Milky Way, that beautiful soft track of light which forms a complete circle of light round the earth, we hold a position in the heavens favorable to an inspection of our neighbors. We are apt to be mislead by the assumption that the brightest stars represent those nearest us. Astronomers have found that distances vary quite irrespectively of brightness, for throughout space we find big and little stars strewn alike in haphazard fashion.

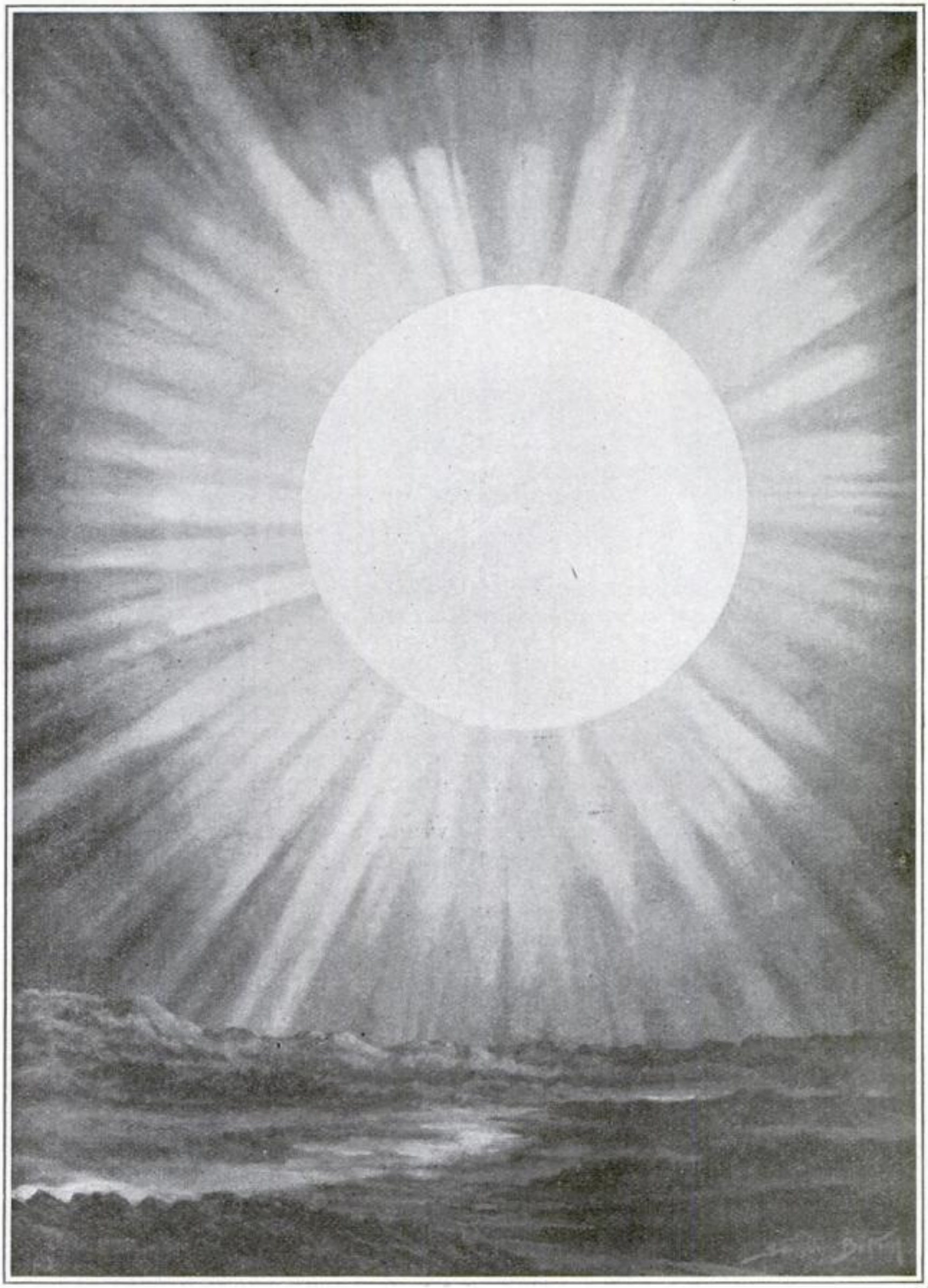
How Small Is Our Mighty Sun!

As in many things common to ourselves, appearances are often decidedly misleading. We might say that our sun is larger than other suns. Careful measurement, however, tells us that our luminary represents just an average sized member of the celestial host. But to say that it attains a diameter of 865,000 miles is a bare statement which fails to awaken an adequate conception of its vastness. If a track were laid along its equator, and a train were to travel thereon at the rate of sixty miles an hour day and night without intermission, five years would be occupied in completing a single journey. The sun's comparative diameter might be illustrated by placing 109 marbles in a row, each one representing the earth. A colossal globe no doubt. But we have only to look around at some of the well-known stars to find the sun's dimensions surpassed many times. Take Sirius, the Dog Star, whose diameter is six times that of the sun. At a more remote distance, so remote that its distance cannot be correctly ascertained, is Spica, a first magnitude star, which, judging from its bright light, must be a sphere at least fifty-five times greater in diameter than our sun. At a similarly inconceivable distance is the well-known star Rigel, which Sir David Gill stated must possess a minimum diameter of seventy-five times that of our luminary.

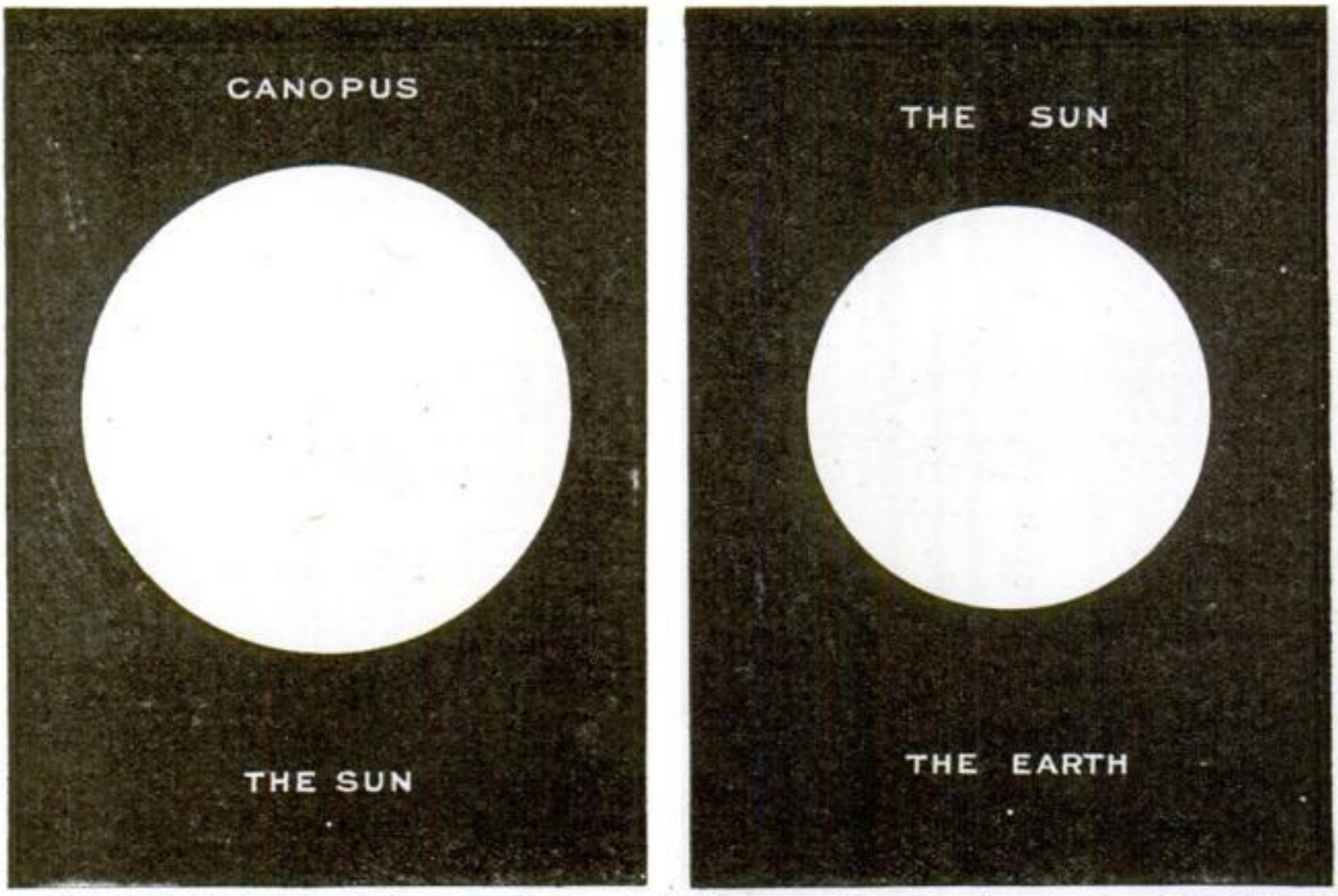
What is the Biggest Star?

In ascending to greater dimensions the

Canopus—Mightiest of Suns



Chiefly of incandescent hydrogen, and probably gaseous to the core, the immensity of Canopus, a first magnitude star in the southern hemisphere, is here shown as it would appear in the sky were it situated even twice the sun's distance from us. Were it ever to come much nearer the earth, we would be scorched by a terrible heat that would kill everything



Size of Canopus (largest star known) compared with sun and earth. Canopus has a diameter 139 times greater than the sun's, and sun's is 109 times the earth's. How little we are!

inquisitive mind asks:—How large is the biggest star known? After years of tedious and elaborate work, astronomers have found that the southern hemisphere possesses a star, called Canopus, which, in point of size, certainly surpasses that of any star yet discovered. It is an appalling object. Although only a fraction of a magnitude less in brightness than the brightest star Sirius, it nevertheless occupies a "back seat" in the heavens. Its distance cannot be less than a hundred times that of the nearest bright star Alpha Centauri, which is similar in *apparent* brightness. Thus we have two stars of the first magnitude but situated in vastly different places in the universe. The rays of light which we are to-day receiving from Canopus were propagated from this giant sun in the fifteenth century. Dwellers on this earth of ours about 450 years hence will see it as it is at the present moment.

In Canopus we have a traveling celestial furnace, emitting 50,000 times more light than does the sun. Its motion through space amounts to something like 1,000 miles every minute. Its stupendous diameter is 139 times that of the sun's, being equivalent to over 120,000,000 miles. Its outer layers are composed chiefly of glowing hydrogen. Not improbably its entire structure, right to the core, represents an incandescent gaseous globe, a remark which may apply equally well to the majority of stars.

We cannot conceive conditions under which matter could exist near the center of such a huge body. On our miniature earth, for instance, pressure due to gravitation in the oceans, amounts to the respectable figure of seven tons every square inch. If now we consider a globe the size of Canopus to be constituted of material having a mean density equal to that of water, at the center of such a globe there would be the pressure of a column of water upwards of 60,000,000 miles in height, besides the corresponding enormous pull of gravitation. If we regard this pressure in terms of terrestrial gravitation it reaches over 67,000,000 tons per square inch. Furthermore, we have the inconceivable heat to contend with at the center of such an enormous body, which must be greater proportionally than at its surface, just as the earth's heat is greater at its center than at its surface.

When the Fighting Relaxes the Bayonet Becomes a Periscope

STUDY the accompanying illustration and you will see what a British Tommy can do with his bayonet, by exercising some cleverness and ingenuity. At the point of the blade is affixed an ordinary trench mirror. By leaning back against the parapet the Tommy can see the outskirts of No-Man's Land and the enemy's trenches in his makeshift periscope. Beside him are two observers.

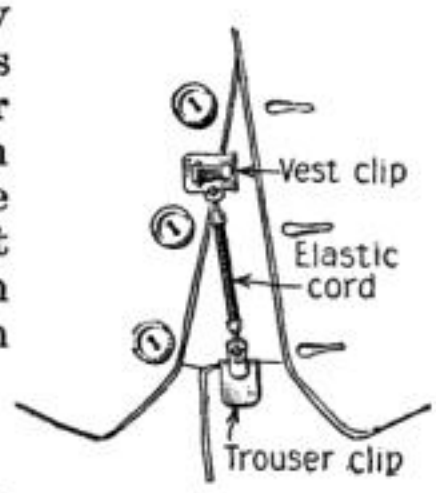
By attaching an ordinary trench mirror to the end of his bayonet blade the Tommy has a makeshift periscope

Why Is the Sun Bigger On the Horizon?

DURING the day when the sun is high, nothing is near it to compare it with in distance, so we think it is small; but when we see it on the horizon with houses and trees and church spires intervening, we believe it to be large. How often have you swallowed this explanation as the truth? To be candid, it is a scientific fib. To prove it, look at the moon from behind a lace curtain or from behind a bush. It will appear not a whit larger.

The real explanation of the sun's apparent dilation is this: The sun is enlarged at sunset because the air magnifies it. Of course the air is in a condition to magnify objects all day. But when the sun stands high, we look up through only a thin layer of air, whereas at sundown our eyes have to pierce the entire depth of the atmosphere—multiplied at least sixteen times. This accounts for the enlargement of the sun. Dust and heated air appear to be the causes of the magnification. Thus the phenomenon is more noticeable in summer and autumn, our dusty seasons.

A Simple Supporter Takes the Place of Suspenders



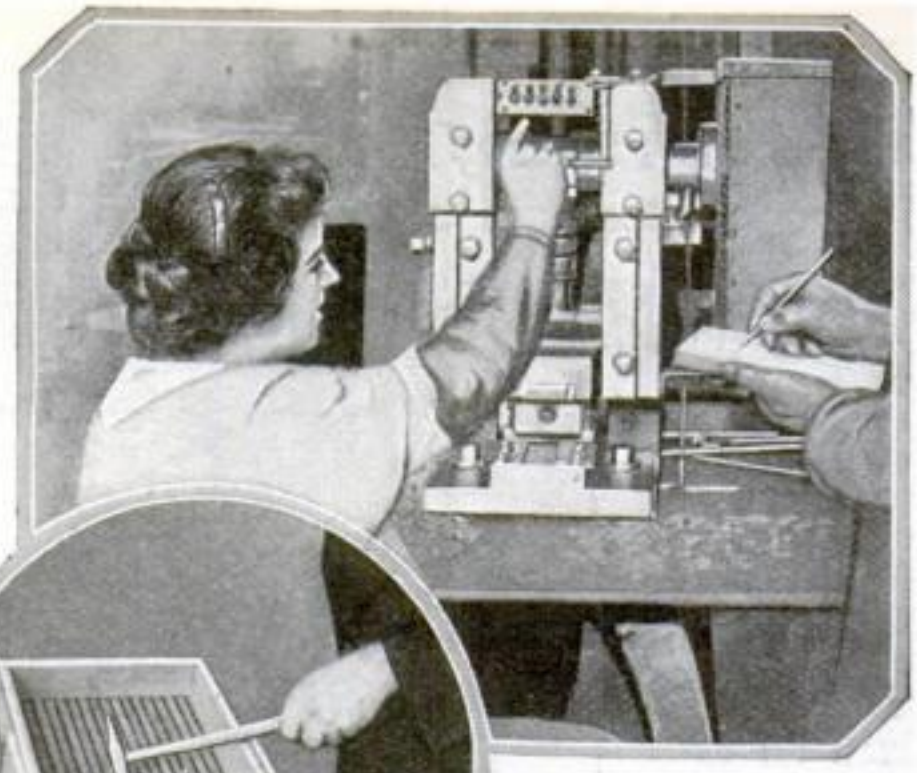
Showing the elastic band with the convenient clips

This supporter holds the trousers firmly to the vest

WHEN both trousers and vest are worn without suspenders, the trousers all too frequently sag below the lower edge of the vest, exposing the shirt. This is very unsightly. To avoid it, William Baake, of West Hoboken, New Jersey, has invented a supporter which fastens the trousers securely to the vest and at the same time allows the wearer full freedom of movement.

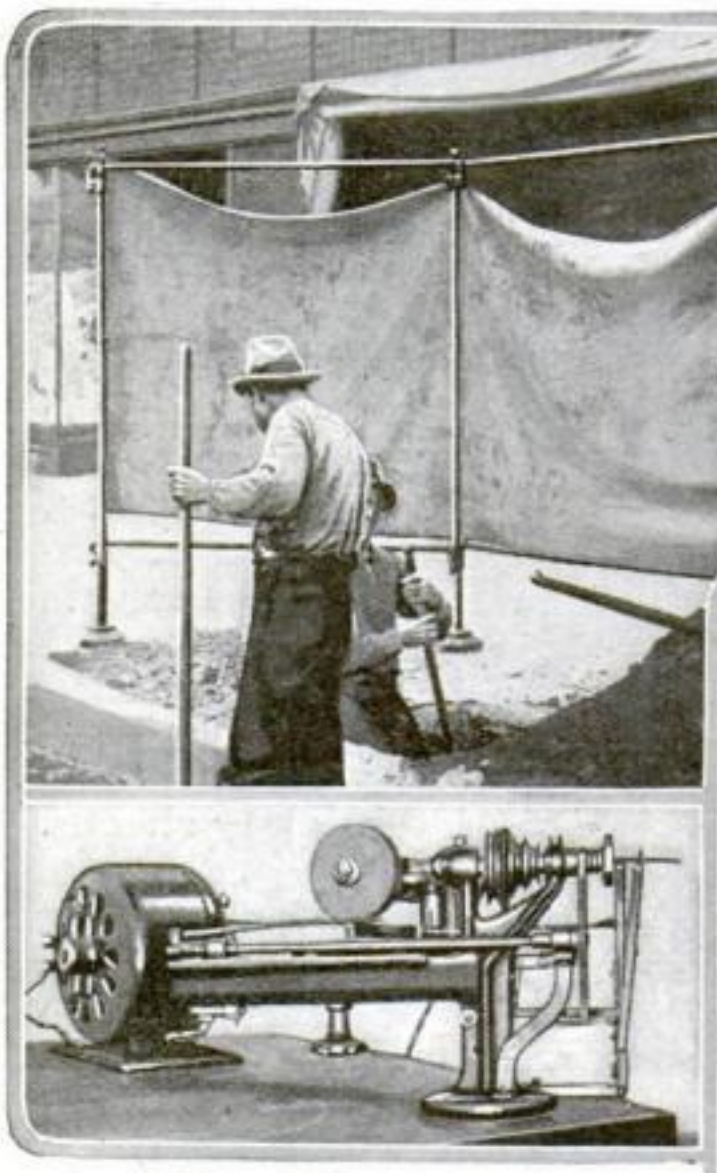
The supporter is a simple elastic strand with clasps at both ends, one for the vest and the other for the trousers. With the vest buttoned, the clasp is invisible.

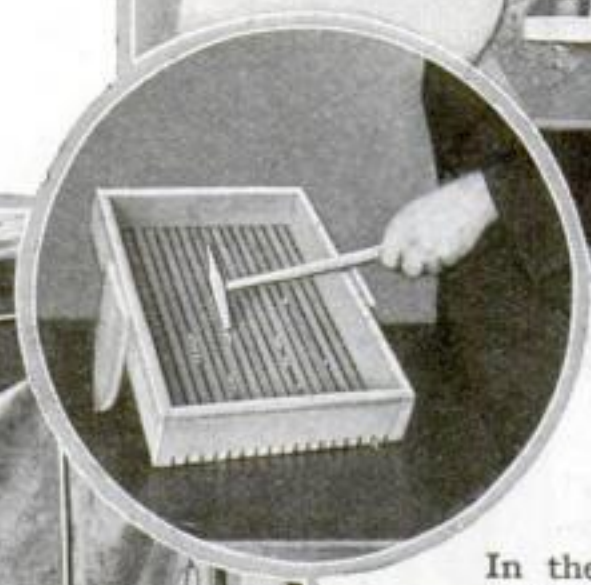
Do It with Tools and Machines—a Baker's Dozen of Efficiency Devices for the Mechanic and Factory Man



This counter attached to a machine accurately records the parts turned out

An especially constructed frame for holding canvas which protects persons from flying bits of pavement blocks or other stone

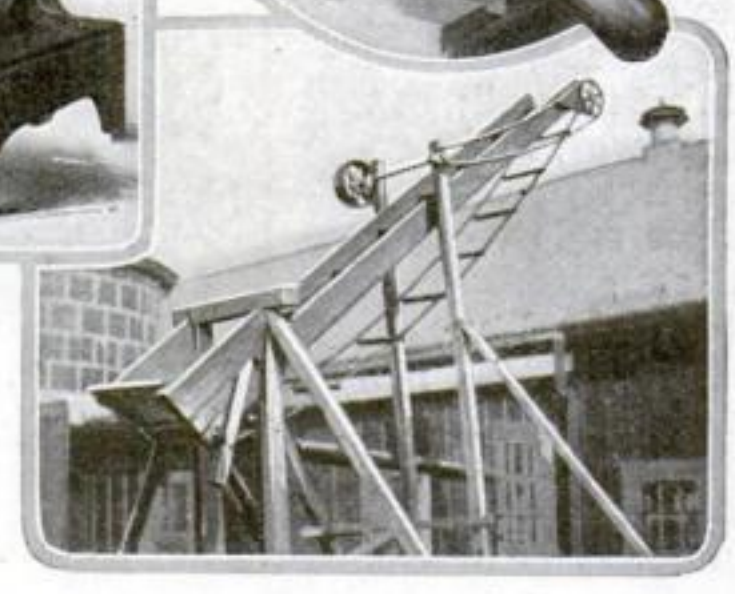




In the upper circle, an arrangement which enables a one-armed man to pick up nails with a magnetic hammer

Below, a clamp to hold a diamond cutter for truing emery wheels

This model maker's lathe which is driven by motor, is fitted with necessary attachments for making fine phonograph needles



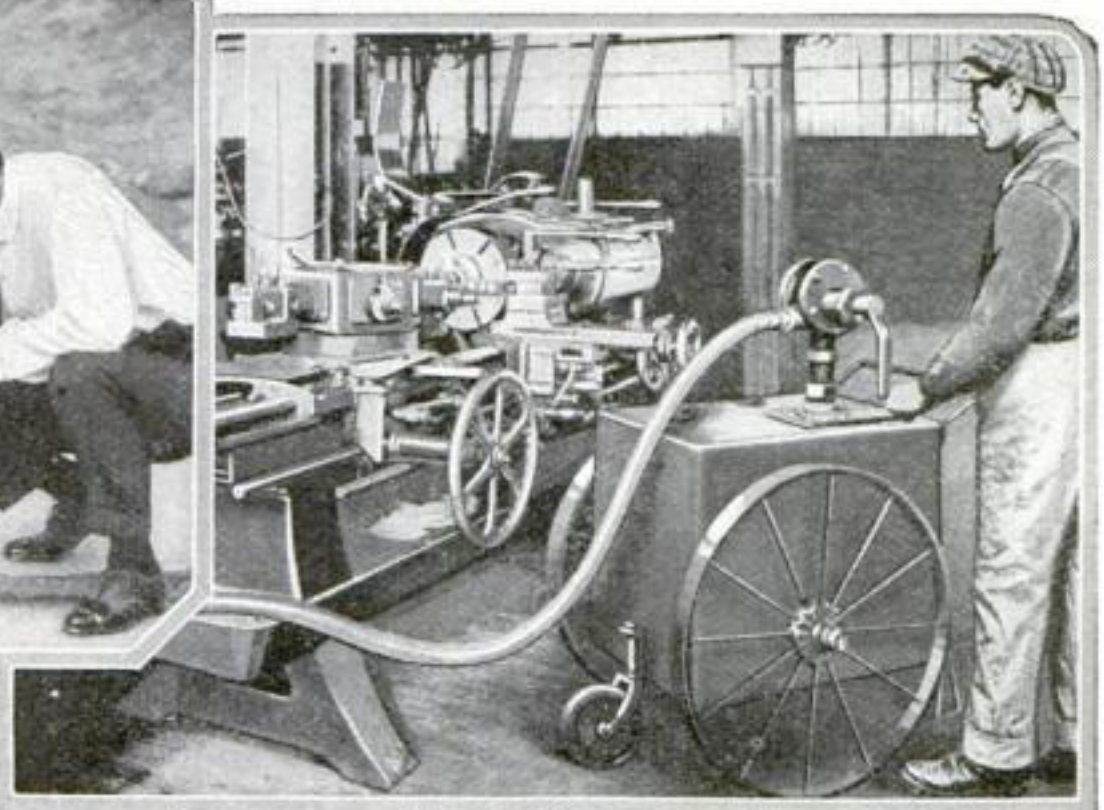
Device for forcing a steel ball into metal to test the hardness of steel

A chain drag used by an industrial school for running shucks and ensilage into a silo. It is run by a belt from a motor or a gasoline engine

At the left, a trailer factory truck in which the front wheel attached to a handle, disconnects and can be used on any number of trailers

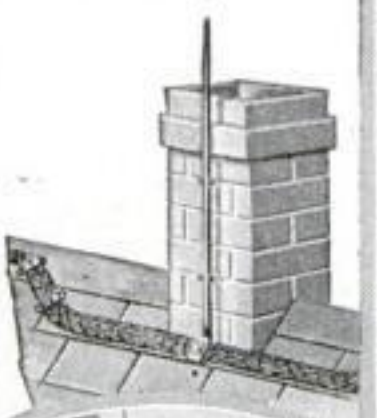
Do It with Tools and Machines

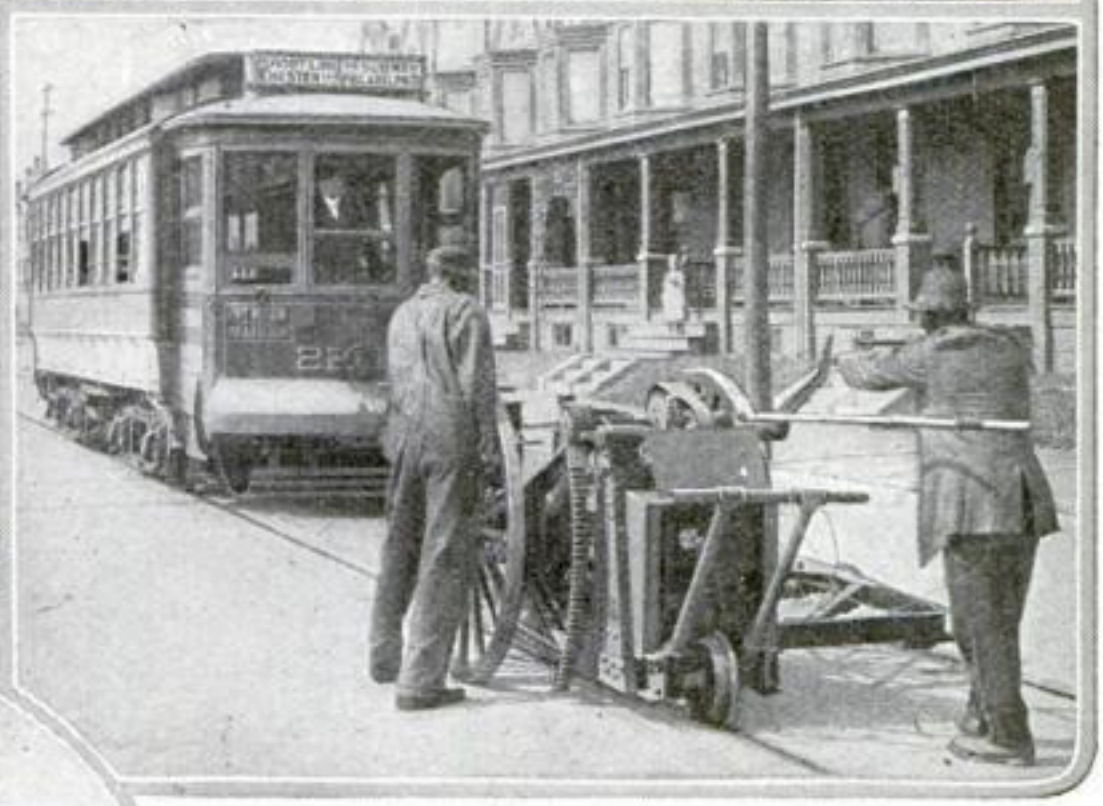
The joint filler should not be flush with the street. This shovel leaves a half inch of the metal extending



In upper right hand corner, a portable shop tank for delivering oils and compounds to machines

At right, a new type of lightning rod, made of numerous copper wires woven into a tight web

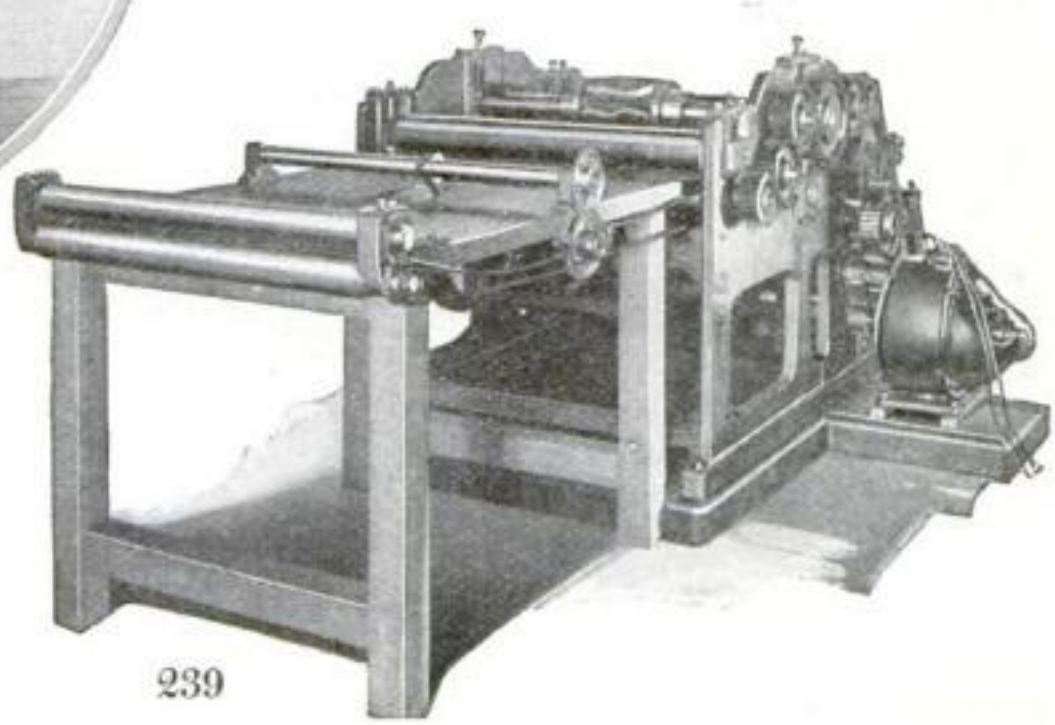




Car rails wear quickly at a spot slightly ground out by slipping wheels, but with this portable grinder the rail's surface is quickly smoothed to the level of the depression

Below, a machine which punches or blanks uncured rubber stock from the rubber calendars, and which is to be used to manufacture rubber shoe heels, water bottles and other articles

Nothing is more annoying to the steam fitter than to have a pipe wrench slip when turning a pipe. Above, a large wrench which a man can trust to hold his weight



A new searchlight has been brought out by Edison which operates on a six-volt storage battery. Focus may be altered to throw either a wide or a concentrated beam. It is extremely useful at fires

Fighting Fires With Searchlights

WHEN Thomas A. Edison's phonograph works at Orange, New Jersey, burned some time ago and he saw firemen confusedly fighting the flames, handicapped and blinded by the lack of light, his active mind grasped the opportunity to solve the fire fighting problem, and as a result we are indebted to him for the portable electric light called by its inventor the "sunlight of night."

This portable searchlight consists of a light, easily handled case of indestructible steel, carrying an especially designed set of Edison's storage cells and having attached to it a powerful electric light with a big projector and intensifying reflector. When the battery is fully charged, the lamp will project a light of 6,000 candle power for 4.5 hours, or 2,200 candle power for eight hours. The lamp and case weigh forty-one pounds and they may be carried by hand or attached to an automobile or fire-engine.

The rays can be focused upon one spot to shed thousands of candle power of concentrated light upon a single window, or the beams may be quickly changed to spread over a wide area. It can be used with perfect safety in the presence of gasoline, broken gas pipes, chemicals and other explosive fumes. This new light is already finding a wide use, not only in fire-fighting, but also wherever light in abundance is required and where it is neither possible nor convenient to run service wires. Where much guarding of factories must be done, as at present, the lamp is likewise of great value.

A Car For Use Where Man-Power Is Cheap

THE odd combination of a man propelled vehicle, with street car rails is to be found in Otsomiya, Japan.

Man-power being cheaper, in that section of Japan, than horse-power, the street-car magnates of the town do not allow humane considerations to interfere with their dividends.

The car shown in the illustration has seats for four passengers. The man behind the car is the human motor that propels the conveyance.

The passengers must have true Oriental patience, because this method of transportation cannot be exactly speedy.

Japanese street car is propelled by a coolie's shoving one foot along the ground

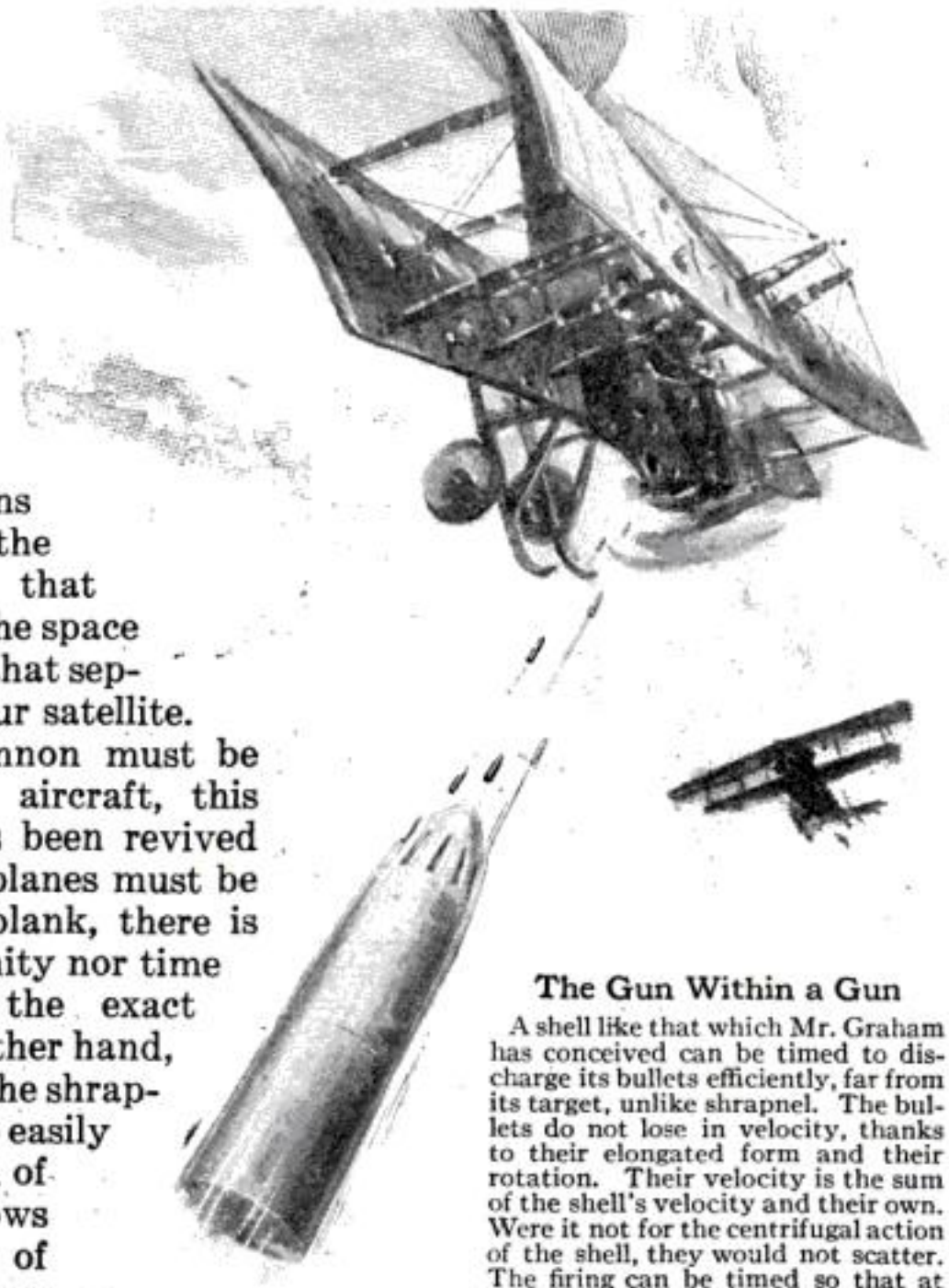
Firing a Cannon From a Cannon

An inventor's ingenious plan to bring down aircraft flying at great heights

ONCE upon a time, so an old fairy tale runs, a lunatic wanted to bombard the moon. He invented a shell that was in itself a cannon. During its flight, this projectile-cannon would discharge another shell, which was also a cannon. And so by firing successive cannons within cannons the lunatic thought that he might cover the space of 260,000 miles that separates us from our satellite.

Now that cannon must be fired at elusive aircraft, this ancient idea has been revived in earnest. Airplanes must be fired at point blank, there is neither opportunity nor time to figure out the exact range. On the other hand, the explosion of the shrapnel-shell is not so easily timed. The hail of bullets that follows the bursting of shrapnel meets so much more air resistance than the shell itself that not only is the scattering effect too great, but the striking force is too small. If by any chance the explosion be timed too early, the scattering effect is not sufficient and the airplane is not winged as a shot-gun wings a snipe or a quail.

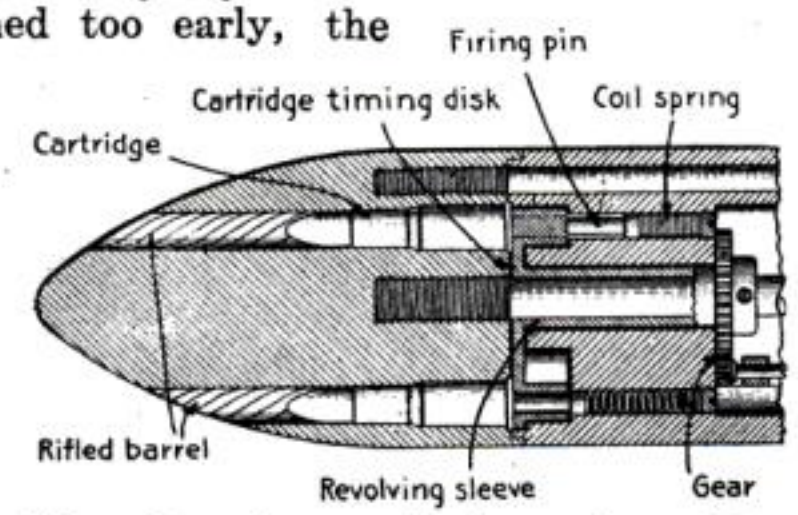
Andrew W. Graham meets this difficulty by inventing a shell that is not merely an envelope to hold bullets together for a certain distance, as in shrapnel, but which, like that in the fairy tale, is a gun in itself, and a very powerful Gatling gun at that.



The Gun Within a Gun

A shell like that which Mr. Graham has conceived can be timed to discharge its bullets efficiently, far from its target, unlike shrapnel. The bullets do not lose in velocity, thanks to their elongated form and their rotation. Their velocity is the sum of the shell's velocity and their own. Were it not for the centrifugal action of the shell, they would not scatter. The firing can be timed so that at least one volley will scatter properly.

The projectile is pierced with a dozen or so of rifled channels, each constituting a barrel loaded with a regulation rifle cartridge. The inventor has provided a lock and firing pin for each hole and a clock-work mechanism to fire simultaneously series of barrels or holes. This mechanism seems a needless and hardly feasible complication. Such is the concussion in a shell when it is fired from a gun that the shrapnel balls must be cemented together. How will clock-work endure a shock that even solid balls cannot withstand? The fuse used in shrapnel, a marvel of accurate mechanism, adapts itself to setting off the charges of the rifled passages of Mr. Graham's shell. By thus discarding the clock mechanism, the barrels or rifled holes can be made longer, which means greater accuracy of fire.



The ordinary fuse used in shrapnel sets off the charges of the rifled passages of the shell

Submarines to Foil Submarines

The Germans showed us how to meet the submarine menace and we haven't learned the lesson they taught us yet!

By Simon Lake, M. I. N. A.

(Mr. Simon Lake, the author of this article, ranks with John P. Holland as a pioneer in the development of the submarine. His reputation as an inventor and builder of submarines and his vast experience as an advisor on submarine questions to the United States Government as well as to the leading European powers entitles the following suggestions of his to very serious consideration.—Editor.)

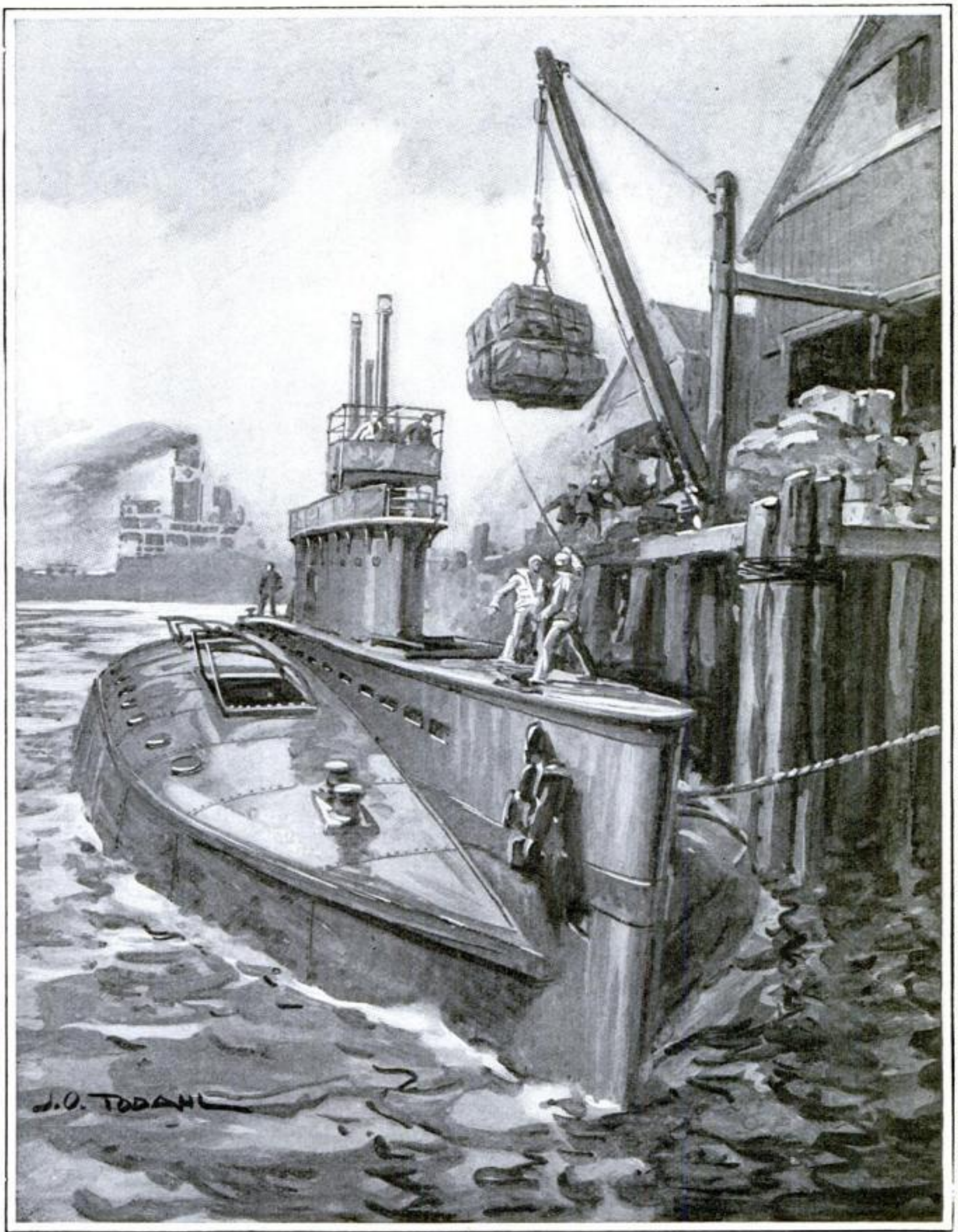
DURING the months of September and October, the German submarines sank *only* twenty vessels a week, according to the dispatches. *Only* twenty ships per week! How many realize that this is the equivalent of 2,808,000 tons in a year, assuming that the average vessel is about 2,700 registered tons? We actually congratulate ourselves that *only* about three million tons a year are sent to the bottom by a method of warfare against which the world is at present powerless.

Despite the five thousand submarine hunting and destroying vessels which Great Britain is reputed to have in the waters of the North Sea and the north Atlantic, despite the nets strung across narrow straits, despite the arming of merchant ships with powerful naval guns, despite convoying torpedo boat destroyers, despite all the experience gained in two and a half years of submarine warfare, the neutral and belligerent seafaring powers of the world are helpless to protect their shipping. The best inventive brains of two hemispheres have been racked in the effort to sweep the German menace from the high seas. And what is the result. *Only* twenty ships a week have been sunk on an average in the months of September and October!

It is obvious that this cannot go on if the United States and her allies are to win the war. We have decided that we must build ships, more ships and still more ships—build them faster than they can be destroyed by submarines. To me, the process is like shoveling coal into a fiery furnace in the vain hope that in some Providential way the fire will be choked. The public and some of our officials lose sight of the fact that the German fleet of submarines must be increasing by leaps and bounds, probably at the rate of about one hundred and fifty vessels a year. If the sinkings are fewer in number than they were, this is due to the fact that today merchant ships, like hunted beasts, take devious courses.

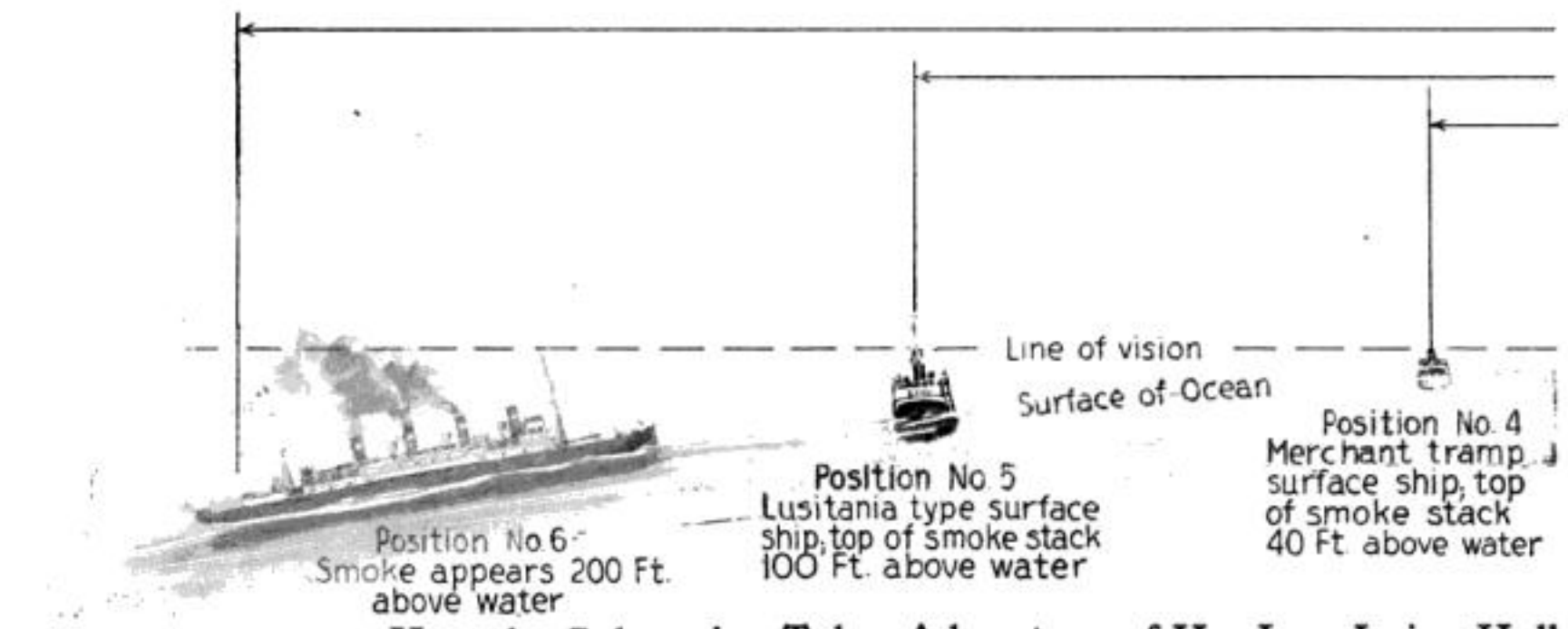
It is not likely that the lost ships will diminish in number; artful dodging on the high seas has its limits. Any device available to a surface ship for detecting and destroying submarines is equally available to the submarine for the detection and destruction of the surface ship. In such competition, the odds are immensely in favor of the submarine; it has the power of becoming invisible at will, while the surface ship is always visible and therefore vulnerable. The nets, shields and protective walls, with which one class of inventors would surround a surface ship, are useless. They slow down the speed so that the ship becomes an easy prey for mines planted ahead by a submarine. I am convinced, moreover, that no object can be made to float on the surface of the sea that cannot be destroyed by the U-boat. I do not believe that any way will be found which will make travel safe for surface ships until a method of seeing through the water for distances of several miles has been perfected, so that submarines can fight each other beneath the surface.

When the Germans sent the *Deutschland* to the United States, they taught us a lesson which we have failed to learn. Here is a ship which made two successful voyages to the United States under conditions that were the severest that could be imagined for a belligerent cargo-carrier.



Loading a Lake Double-Hulled Cargo-Carrying Submarine

In Mr. Lake's opinion, the cargo-carrying submarine of low speed is the only type of vessel which can escape the German U-boat. She has low visibility and is able to disappear. She has all the qualities possessed by her enemy. She may beat him at his own game. Mr. Lake maintains that "vessels of the ordinary type will in no way suffice to meet the great problem which today confronts the democratic nations of the earth. They must and will eventually come to the point where they will adopt the submarine to beat the submarine"

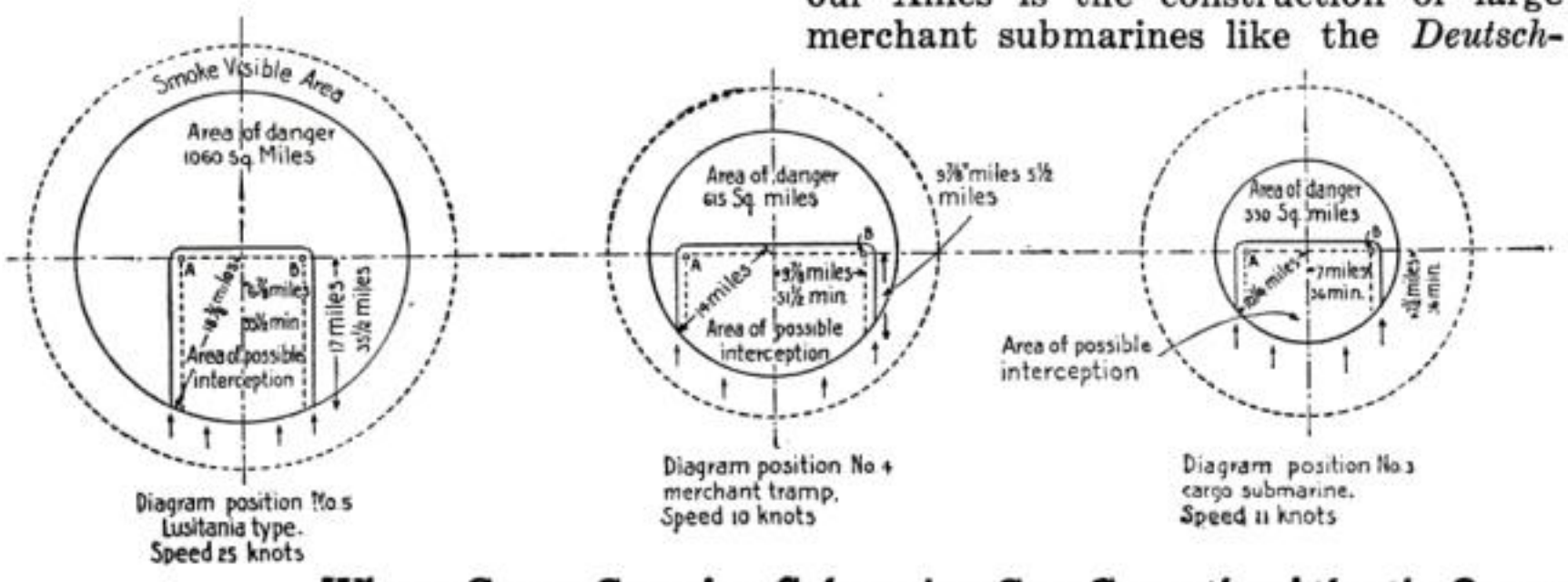


How the Submarine Takes Advantage of Her Low-Lying Hull

This diagram, shows the comparative visibility of vessels when seen from a military submarine and gives the distances at which the various parts of a large ocean steamer such as the Mauretania, with smoke-stacks extending one hundred feet above the surface of the sea, would be visible to a distant observer fifteen feet above the surface. Assume that the Mauretania is making her maximum speed of about twenty-five knots. By referring to the diagram it is seen that her upper works become visible above the horizon at a distance of eighteen and three-eighth miles from the periscope of the submarine. By using his range and direction finder, the submarine commander can determine the course of the vessel and figure out just when and where he can intercept her (position No. 5). In the case of a slow tramp, the smoke from the stack will first betray her approach. Her smokestacks are probably not over forty feet above the water level; therefore, if she were making the same course as the high-speed ship, it would be observed by referring to position No. 4 and the data there given, that the submarine at a speed of ten knots has more time to get nearer the course of the approaching ship and can have more time to calculate the enemy's speed of approach and

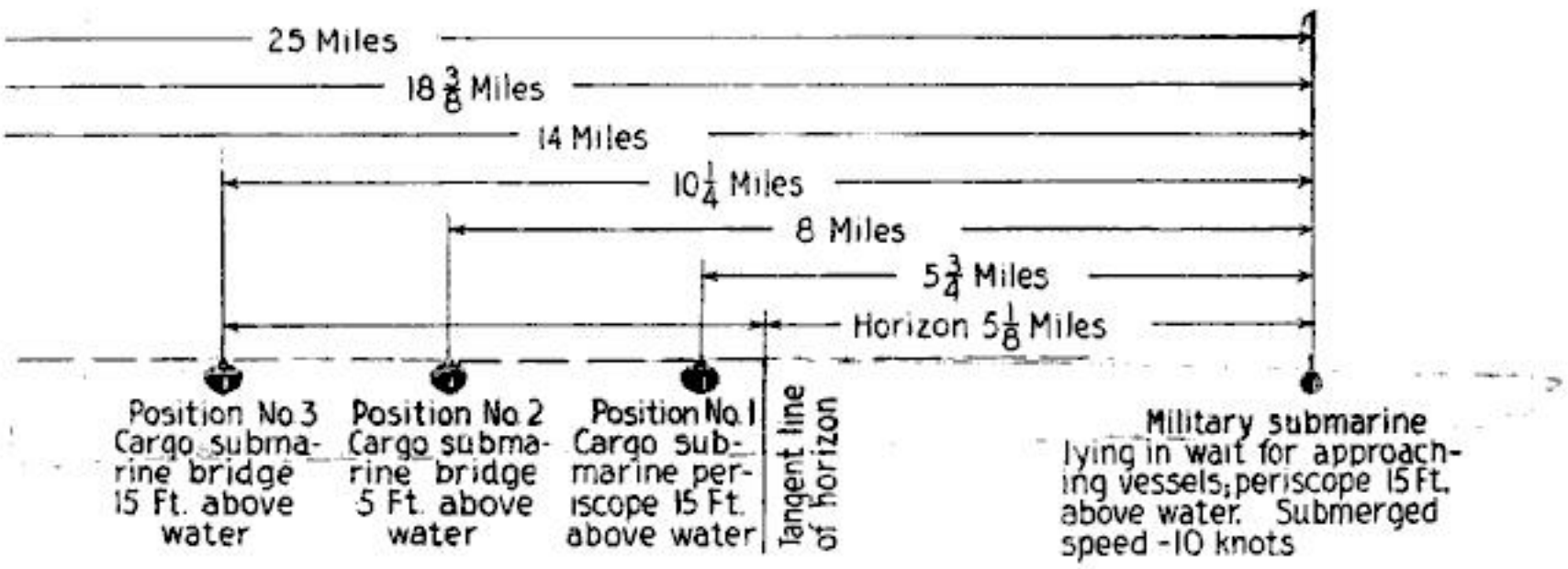
She eluded not only the hundreds of vessels which swarm in the waters surrounding Great Britain and which are constantly on the watch for submarines, not only the seaplanes and dirigibles which patrol the British coast, but also the British cruisers on the Atlantic seaboard of the United States. No vessel spoke her on the way. She entered Baltimore and New London with dramatic unexpectedness, unloaded her coal-tar dyes, shipped a new cargo of nickel and other German necessities, and calmly sailed for home.

In my judgment the only way in which we can thwart the submarine, the only way in which we can continue to send much-needed fuel, food and supplies to our Allies is the construction of large merchant submarines like the *Deutsch-*



Why a Cargo-Carrying Submarine Can Cross the Atlantic Ocean

A cargo-carrying submarine, traveling with a freeboard of five feet would become visible to a submarine lying in ambush when she approached within eight miles. This increases the area from one hundred and three square miles as shown in position No. 1, to two hundred and one square miles as shown in position No. 2. In comparison with the usual type of surface cargo-carrying ship—a tramp, for instance,—the submarine freighter is safe; for she has the ability to submerge in less than two minutes. Moreover, it is hardly likely that she will be attacked without warning for fear she might be a friendly military submarine. When far from land, she could navigate entirely on the surface with a freeboard of fifteen feet, in which condition she can make a speed of eleven knots as



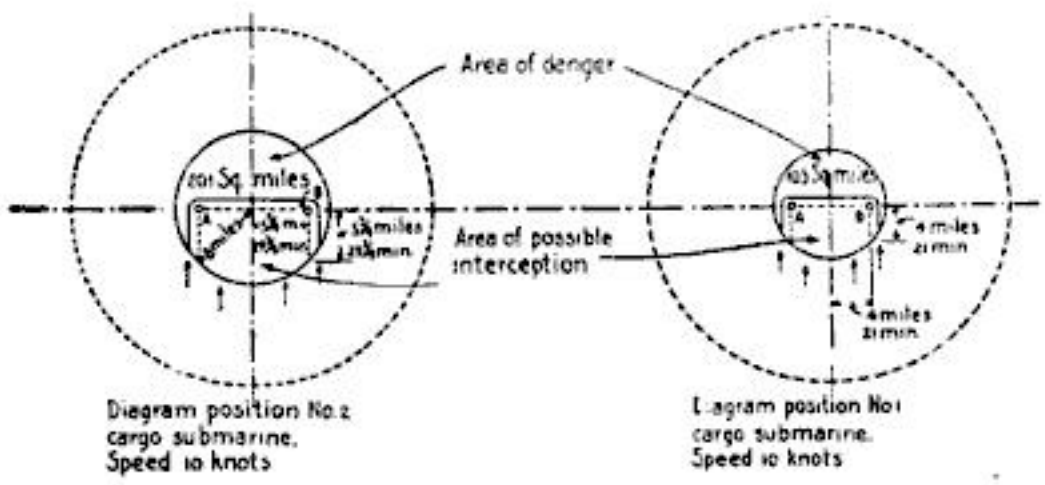
and Keeps the Big Ship in View While She Is Herself Unseen

direct course than if she were intercepting a fast Mauretania. Assume that this approaching slow-speed craft had no solid opaque portion extending over fifteen feet above the surface of the water, as in the case of the cargo submarine shown in position 3. She would pass the waiting submarine below the horizon, and the intervening round of the sea surface would prevent the submarine from seeing her. She would pass by unseen and in safety. In the various positions here shown, the submarine is assumed to have a submerged speed of ten knots. It is evident that practically one hundred per cent safety would be secured, could

cargo-carrying submarines cross the ocean and remain invisible during the entire journey. This is, of course, impossible, because there is no means of supplying sufficient power for long under-water voyages without drawing on the upper air. But the diagram shows that a cargo-carrying submarine running awash, with her periscope and air-intakes alone above the water line, may approach within about five and three-quarter miles of any waiting military submarine without danger of being seen; for her betraying wake would be far, far below the horizon of the most watchful, ruthless enemy submarine afloat.

land. I can see no sense in building million dollar ships, loading them with several million dollars worth of cargo and sending them out to be sacrificed, when absolute immunity from attack can be secured at an additional first cost of not over two hundred and fifty thousand dollars per ship, or about eight per cent of the value of the ship and cargo (less than the present immense insurance rate on one voyage to England). For a supposedly inventive and progressive people, we are curiously prejudiced. Here are the Germans with their reputation for stolidity and slow-thinking successfully attacking very much the same problem with a boldness and an imagination which they themselves attribute to Americans. And we—we seem to be paralyzed by a conservatism inherited from our English ancestors.

The truth is that the submarine is a mystery to our shipping men. It takes a combination of liberal-mindedness and special knowledge to set a fleet of merchant submarines afloat. Despite the example of the *Deutschland*, despite the enormous profits which that vessel admittedly made for her owners, we still go on building surface ships, many of which must inevitably succumb to German submarines.



Without Danger of Being Torpedoed

in position No. 3. This increases the danger area to about three hundred and thirty square miles, about three times the danger area shown in position No. 1. But as the area to be covered by the military submarine on the high seas far from land is also much greater, the real danger would be proportionately less than the lower visibility in a more thickly infested zone might lead one to suppose.

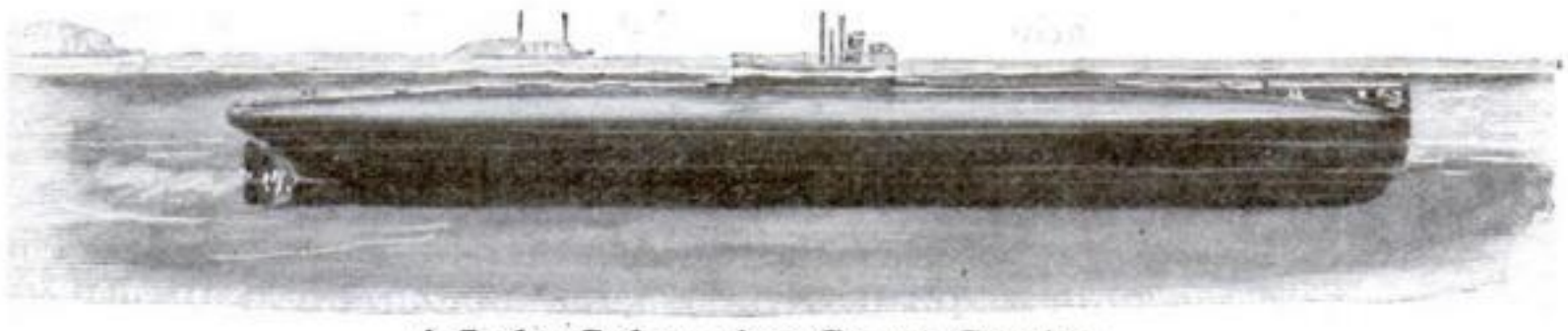
When our shipping men and our naval authorities realize the importance of invisibility and learn that the submarine is the least visible of all vessels, perhaps the rational solution of the problem here advocated will be attempted. The only effort at present used to secure invisibility is to be

found in the use of the smoke screens advocated by the Government. Smoke is exactly what the German submarine commander is looking for. The sea captain obliges him by throwing overboard a fuming box made according to Government specifications. The submarine submerges in advance of the smoke, rises within the smoke pall, gages the distance of the surface vessel with her several detectors and then plants one or more torpedoes successfully. Over fifty per cent of the vessels attacked are sunk. The smoke even hides the wake of the torpedo itself; it removes the only chance to escape which the vessel might have.

I have illustrated this article with a few diagrams showing the advantage of various types of vessels in evading the submarine. The captions beneath the diagrams will explain the points illustrated. Here, it may be stated as a general principle, that visibility and speed depend upon elevation above water-level. When the sun or moon sinks beneath the horizon they cannot be seen. Neither can anything else be seen which is below the horizon. Such is the curvature of the earth that a hill of water intervenes.

It is obvious that absolute safety could be attained if a submarine cargo-carrier could travel entirely under water. That is at present impossible for good technical reasons. But a cargo-carrying submarine running awash, with her periscope and air-intakes just above the waterline may approach within about five and three-quarter miles of any waiting military submarine without danger of being seen. Her wake would be below the horizon. Such cargo-carrying submarines can be built and can cross the Atlantic Ocean in this condition, at a speed of about ten knots. If a sharp lookout is maintained, they have as much chance of seeing a German submarine as the German submarine has of seeing them. By the application of certain tried devices, which I do not feel it proper to divulge at this time, but which are within the knowledge of our Government authorities, in my opinion, the range of visibility can be reduced to less than one mile. The cargo-carrier can become entirely invisible by submerging. If she travels with a freeboard of five feet, she will become visible to a German submarine when she approaches within eight miles. In two minutes, she can dive under water. It is hardly likely that she will be attacked without warning lest she be a friendly submarine. She will be warned by wireless, sound, or other signals used by German submarines to communicate with one another. Her one business is to deliver her cargo and not to communicate with or expose herself to either friend or foe. When far from land, she can follow the *Deutschland's* example by navigating entirely on the surface with a freeboard of fifteen feet. In that condition, she can make a speed of eleven knots without the slightest difficulty.

Sooner or later it will be recognized that the Germans are carrying on their submarine campaign, not in a haphazard fashion, but systematically. Every ship sighted by a submarine is a marked craft. Even if she is the fastest vessel afloat, she may speed unwittingly into a trap set for her by wireless. If she cannot disappear, she has no real ability to escape. On the other hand, the cargo-carrying submarine of low speed has both these advantages. She has low visibility and she can submerge quickly By the simple expedient of descending beneath the waves, she becomes invulnerable She has the most valuable attribute possessed by her enemy, that of becoming invisible. You cannot successfully attack a ship whose location is unknown.

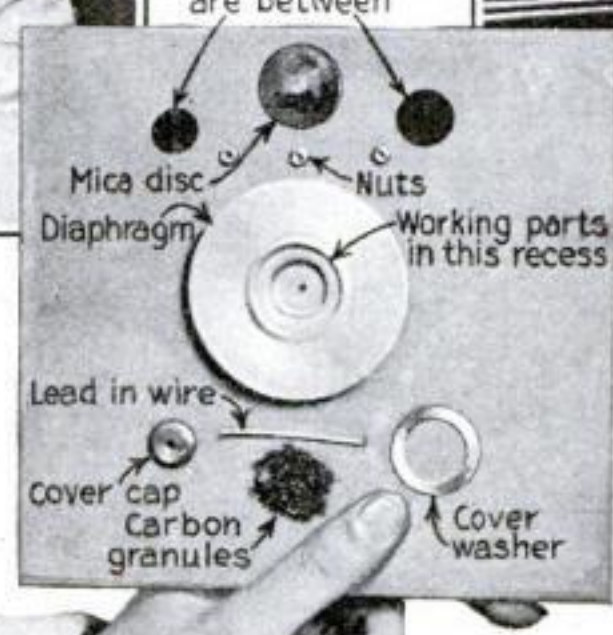


A Lake Submarine Cargo Carrier

It carries 7500 tons dead weight of cargo and can safely be navigated to depths of three hundred feet. By eliminating the top hamper and deck house used on ordinary surface vessels, the hull weights of such a submarine are only slightly in excess of the hull weights of a box-shaped, surface, cargo-carrying ship.

The girl is holding the bare diaphragm in her hand and easily carrying on a conversation

Below: The parts of the transmitter. Simple construction is possible since outside framework is unnecessary



The instrument can be submerged in water and it will still work, as illustrated above

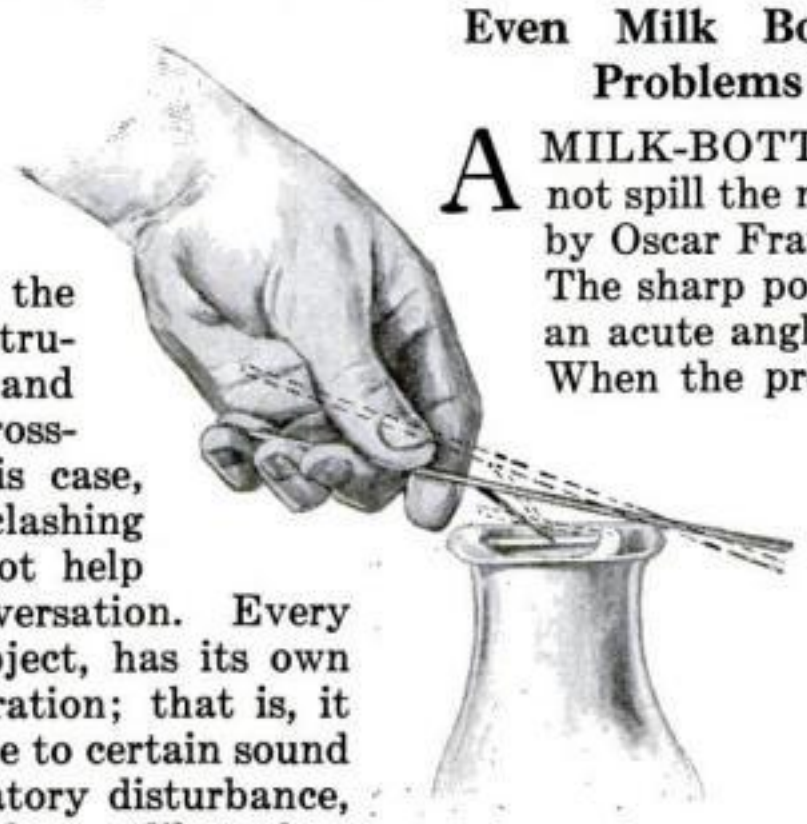
At Last! A Noiseless Telephone

TRANSMITTER inventions there have been without end, but one which promises to dispose of side tones is being put out by a Chicago company. Side tones are troublesome hums, rattles, jars, and vibrations which make it impossible for a person to carry on an uninterrupted conversation. The principal cause for the presence of these extraneous noises is the fact that the whole outer case of the transmitter is receiving the sound vibrations; and, since the inner parts of the instrument are all held and trussed in place by cross-pieces fastened to this case, the result is an interclashing of noises which cannot help but interfere with conversation. Every piece of metal—or object, has its own natural period of vibration; that is, it is peculiarly susceptible to certain sound pitches, or other vibratory disturbance, and thus it responds readily when these pitches are reached. Sensitive as a transmitter is, it takes notice of all these vibrations.

The Chicago invention would get around these difficulties by attaching the working parts of a transmitter to the diaphragm (that round disk you talk against), leaving the case free. The parts are small, and consist of the usual carbon granules between two disks. Aside from being free from side tone, the new transmitter is said to be remarkably sensitive. It can be submerged in water without in the least interfering with the conversation.

Even Milk Bottle Openers Are Problems in Mechanics

A MILK-BOTTLE opener which does not spill the milk, has been invented by Oscar Frank, of Cleveland, Ohio. The sharp pointed prong juts out at an acute angle from a little flat bar. When the prong pierces the cap, it does so in an almost horizontal direction. The cap is thus pressed against the side of the bottle and not toward the bottom. The lift of the cap meanwhile takes place as it slides up the incline of the prong, and the contents of the bottle are not spilled on the hand.



The opener is worked sideways and no milk is spilled from the bottle

A New Portable Electric Light for Manhole Work

NO longer will it be necessary for workers in sewer, telephone or electric conduit manholes to grope their way in the darkness or to burn their fingers with the exposed flames of candles or kerosene lamps. A large Eastern electric concern has just brought out a portable lighting outfit which weighs only forty pounds and which is provided with two twelve candle power lamps which can be lighted at the same time for ten consecutive hours.

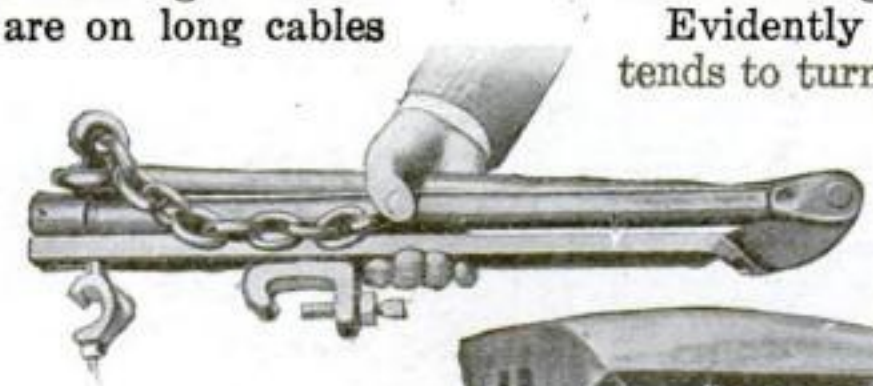
The contrivance consists of a small metal case inside of which is fitted a little five-cell storage battery which can be allowed to stand idle indefinitely in any condition of charge or discharge. Both of the electric bulbs are on long cables and are provided with wire guards and metal shields to concentrate the light on the work being done.

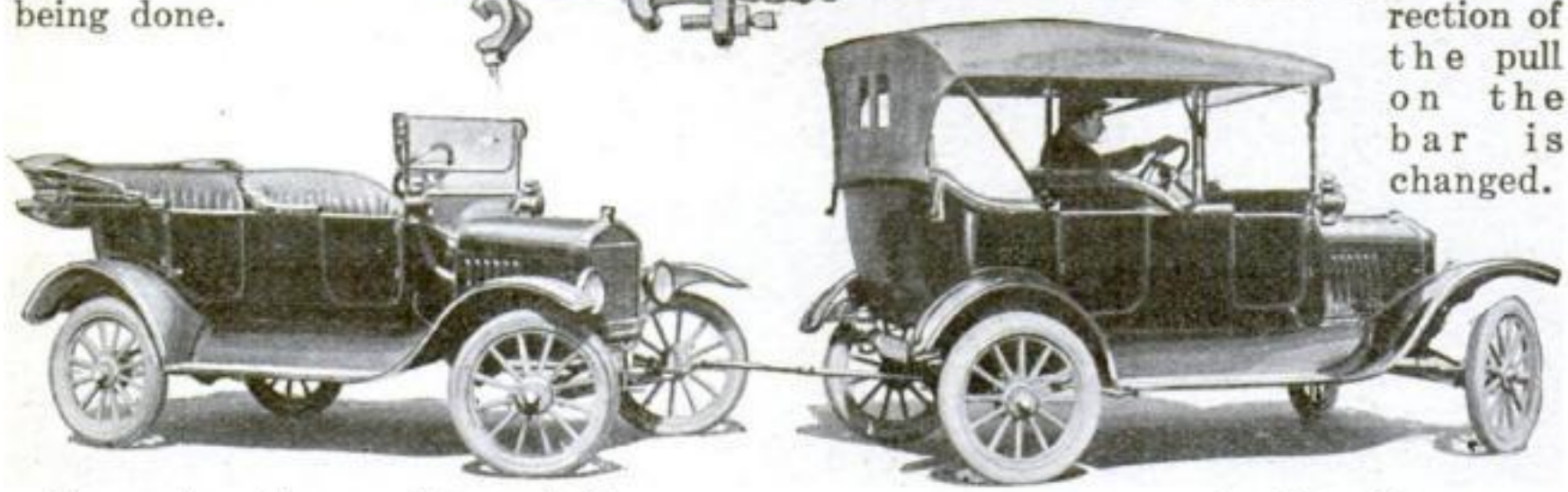
Using the portable lighting outfit, which weighs only forty pounds, for manhole work

How One Man Can Both Tow and Steer a Disabled Automobile

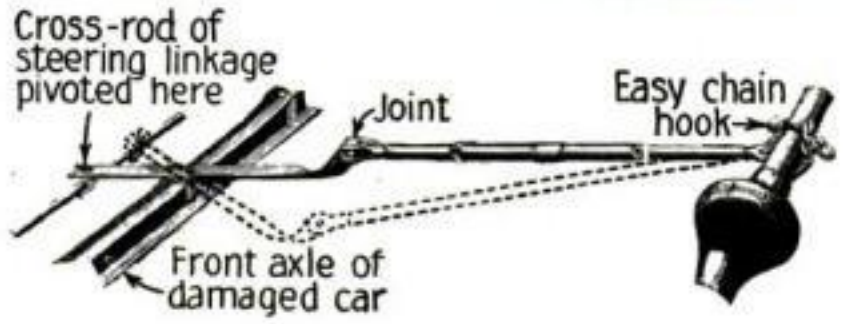
A NEW draw-bar towing device enables one man to both tow and steer a disabled automobile to the nearest garage for repairs. The unit is designed particularly for use in connection with Ford automobiles. It consists of a hinged two-part rod which is attached to the rear axle of the towing vehicle by means of a chain, and to the front axle of the damaged car by means of a special clamp and set screw. The rearmost part of the rod, made of a flat bar, differs from other types of towing units in that it extends back of the axle of the towed vehicle and is attached to the cross rod of the car's steering linkage.

Evidently the draw-bar rod tends to turn the front wheels of the towed vehicle as the towing vehicle turns a corner and the direction of the pull on the bar is changed.





In center above: The tow-bar collapsed to fit into the tool box. Directly above: The tow bar in use

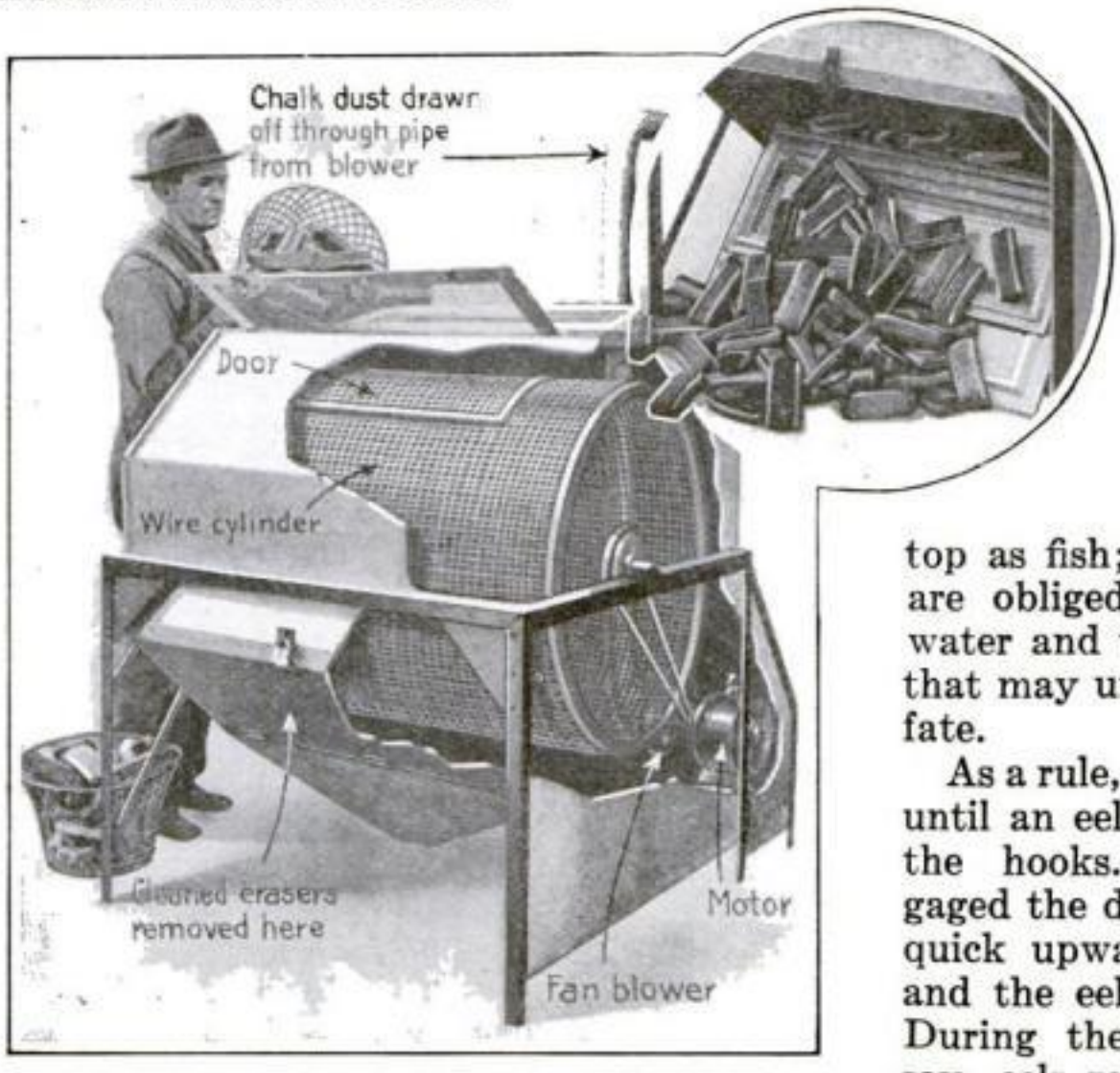


At left: The rear part of the bar pivots about the clamp over the front axle of the damaged vehicle

Cleaning Five Hundred Blackboard Erasers at a Time

EVERY school teacher knows how difficult it is to keep the blackboard erasers clean, and to prevent chalk dust from being thrown out into the air of the school-room, where it must be breathed by the pupils. To remedy this, a machine has been invented which cleans five hundred erasers without throwing dust into your eyes and nose.

It consists of a revolving drum of heavy wire netting or perforated iron, inclosed in an outer casing. The erasers are placed in the drum, which, as it revolves slowly, bumps them about and extracts the dust. At the same time, a rapidly revolving fan draws a current of air over the erasers, causing the chalk dust to be gathered up and wafted away through a pipe opening into a chimney or convenient ventilating flue. The machine is run by a motor. It not only cleans the erasers thoroughly, but keeps the felt in excellent condition. A machine, similar to the one shown, works by a handle and crank. It cleans one hundred erasers at a time.



When the chalk dust is shaken from the erasers, it is drawn off through a ventilating flue

© Brown & Dawson

Hooking eels through the ice. It is not as easy as it looks. Try it some winter's day and you will be convinced

You Don't Spear Eels in Winter—You Hook 'Em

SPEARING eels at night under the glare of a lantern or pot of fire fastened over the water to the bow of a boat, is an enjoyable summer and winter sport. In summer, eels are jabbed with a three-barbed spear. In winter they are taken with an eight-tined hook. It takes about ten times as much labor and patience to hook an eel through the ice as it does to jab one through the open water. Try it some cold winter's day and you will be convinced.

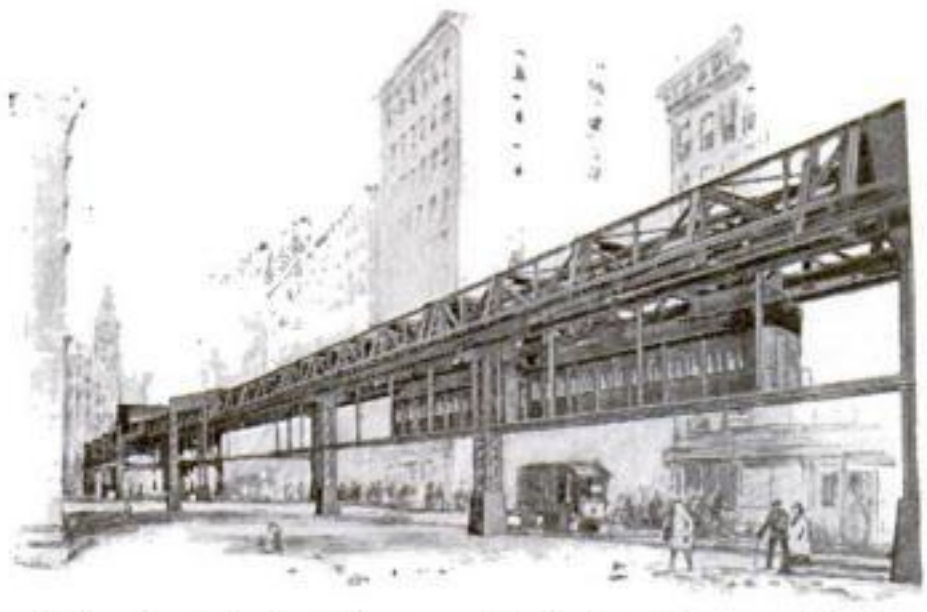
After the hole has been cut or dug through the ice, the eel hunters stand ready with their poles, waiting for their prey to come to the top. But the eels are not so anxious to come to the top as fish; consequently the hunters are obliged to reach down into the water and to hook any curious victim that may unwarily wriggle along to its fate.

As a rule, the poles are held stationary until an eel swims a few inches above the hooks. When the hunter has gaged the distance correctly, he gives a quick upward movement to his pole and the eel is impaled and held fast. During the winter nights, strange to say, eels remain at the bottom of an ice-covered stream.

The Single-Track Hanging Railway

It saves money in building and it uses the middle of the street

THE airplane and the submarine were born years ago. In their early youth they were unable to prove how powerful they would be in later years, and most people scorned their promise for the future. Inverted railways, so called, because the cars hang from the rails, must fight the same battle for recognition. There are still many people who ridicule this type of railway, even though a successful one has long been in operation between the three German manufacturing towns, Vohwinkel, Elberfeld, and Barmen.



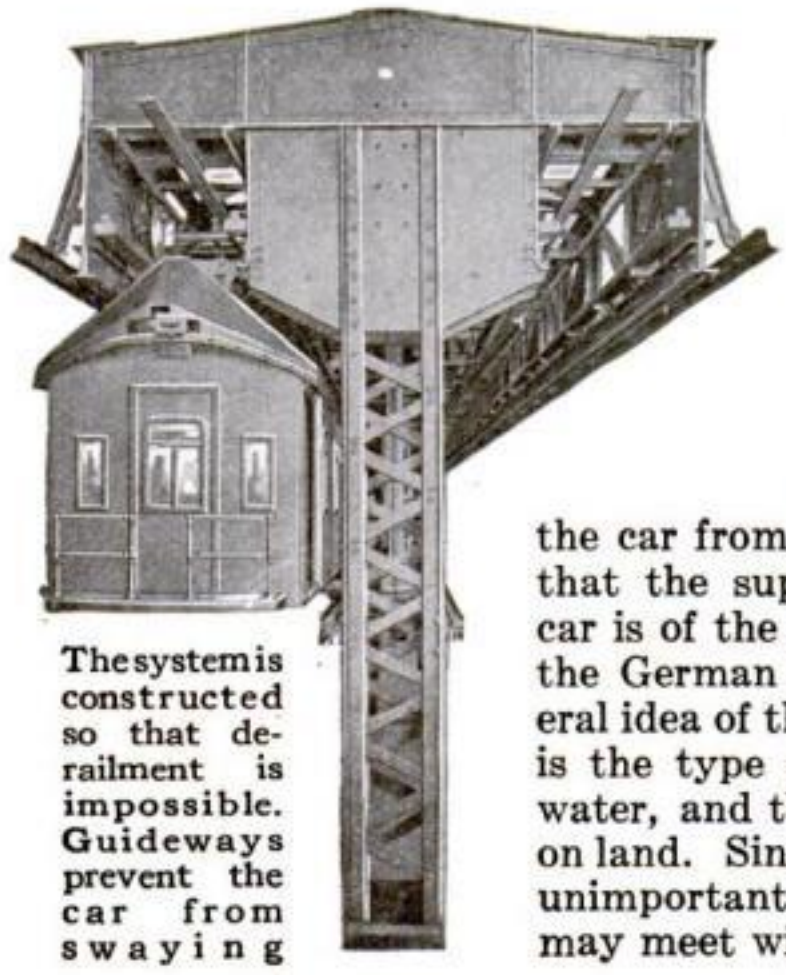
The inverted railway. Central columns filled with concrete, support the entire structure

A railway somewhat similar to the German one has been proposed by J. B. Strauss of Detroit. This inverted railway has been suggested for use in our large crowded cities where traffic conditions are bad. Of the many advantages claimed for this system, the most important are the reduction of space occupied, of noise and of danger.

A general idea of the Strauss system is presented in the illustration. Here it will be seen that a central column supports the entire structure. Traffic conditions on the street below would surely be better with this single type of column than they are now with the two column system for, with our "keep to the right" regulations, the center of the street is not much used.

Many ways are suggested by which the customary noise of an approaching train on an elevated railway may be eliminated. Since the driving mechanism is above the train, it can be easily enclosed. The way in which the car is supported makes the use of ordinary ties unnecessary. The supporting posts are filled with concrete.

Since the desire for self-preservation is very strong within us, we naturally feel that the safety of such a railway is really the prime factor. In regard to this, we may be sure that derailment is impossible. As the rail is enclosed, snow and sleet cannot affect it. The system is so constructed that the car cannot fall. Shoes at the sides and bottom of the car ride on a guide rail in order to prevent the car from swaying.



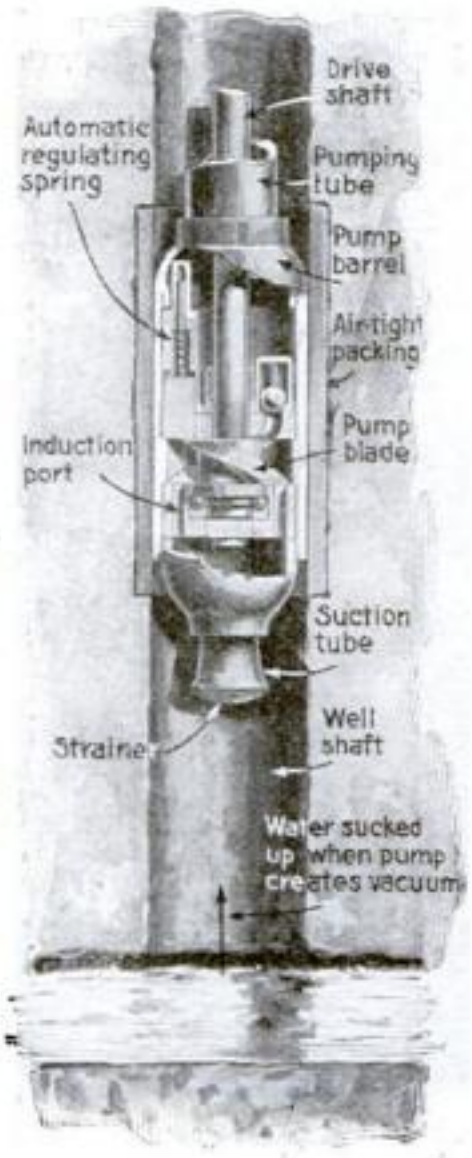
The system is constructed so that derailment is impossible. Guideways prevent the car from swaying

In comparing this proposed system with the successful one in Germany, we find only two noticeable differences: one is that springs instead of a guide rail prevent the car from swaying; the other is that the support which holds the car is of the double column type in the German railway. A very general idea of this is here shown. One is the type of support used over water, and the other the type used on land. Since these differences are unimportant, the Strauss system may meet with success.

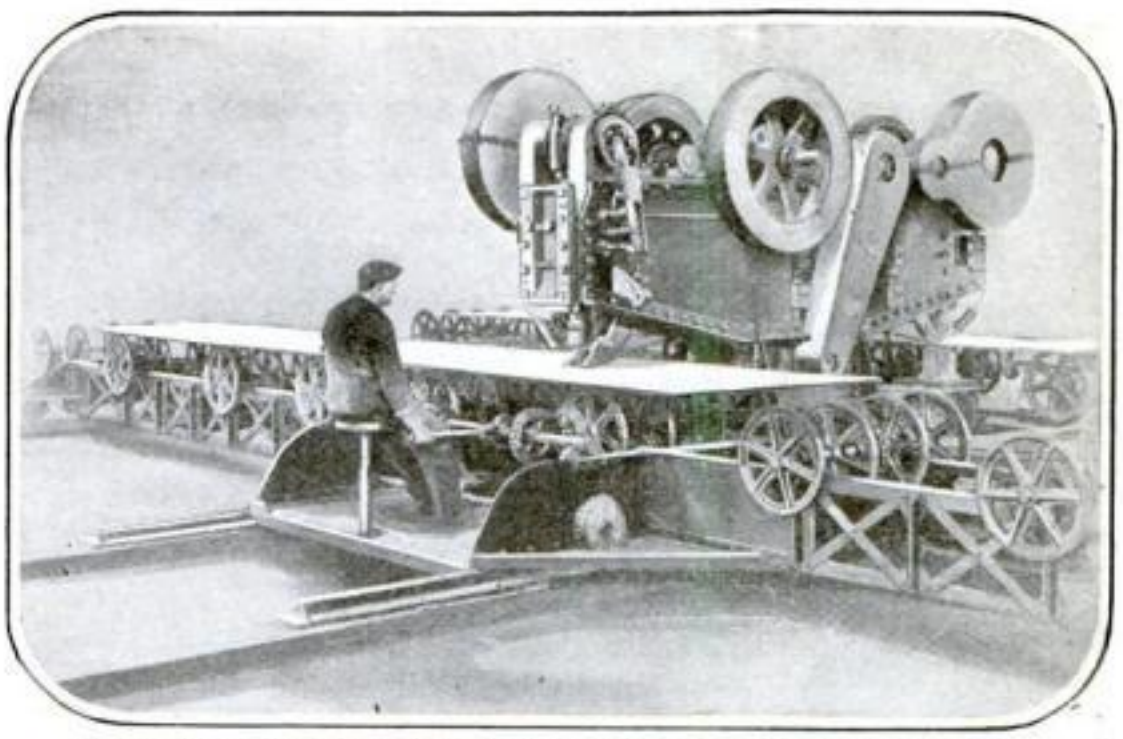
Making the Desert Bloom like a Flower-Garden

SAMUEL LIPPERT, veteran inventor of Cleveland, Ohio, writes us that he has developed a pump which he thinks some day will perform no less a feat than to make the Sahara desert a flower garden! Pumping water, he reminds us, has been a serious question ever since Biblical days when Jacob's well was drilled.

Lippert proposes to use "the free energy of the air." Not any other free energy, however, than that of the wind. Even the sporadic winds of the Greatest Desert can operate his pump, since it is rotary and is self-checking. A vertical shaft, leading from the mill vanes down to within a score of feet of the deeply-buried stream, rotates a set of screws fitting tightly against the inside of the pump casing. A corkscrew action is produced, and the water is sucked up the first twenty feet of the distance. All the rest of the journey, the water is simply screwed up.



The rotary pump for tapping deep underground streams. It is driven by a windmill



One man working at this machine can punch over four thousand holes in heavy plate during a nine hour day

Punching Holes in Steel Plates—A Machine Used by Shipbuilders

PUNCHING more than four thousand holes in heavy plates during a nine hour working day is a modern accomplishment. It could not have been done so recently as a year or two ago. Plates for building ships must have many holes so that they can be riveted together into a finished vessel. The great expansion in steel shipbuilding industries has made the rapid handling of plates at punching machines a real necessity. The plate punch roller shown in the illustration has made this rapid handling possible, and it is in use in many of the new plate shops.

The plate is laid on the table and the operator, from his seat, moves the table backward and forward with the aid of an operating lever at his right hand. At his left hand is another lever, which can be operated to move the plate sideways, thereby placing it in the desired position for punching. The punch is controlled by a foot lever.

Plates from one-quarter to one-eighth of an inch thick, and up to thirty by eight feet in size are handled. The tables are built with roller bearings.

The inventor holding a small model of his rotary pump

Another Use for Tree Roots. Make a Fence of Them

WHAT shall be done with tree roots after they have been dug or dynamited from the soil to prepare it for the plow? The answer is given by a farmer who lives in a western state where the barbed-wire fence is in general use. Gathering several hundred tree roots, he transported them to his farm and there arranged them to take the place of the usual wire fence.

© Brown & Dawson

Roots of trees arranged to serve as a fence. They answer most of the purposes of barbed wire

There are hundreds of miles of fences in the far West which serve merely to indicate the dividing lines between adjacent ranches. Discarded tree roots answer the purpose as well as wire. As a rule they are never used for fire wood, principally because they are hard to saw into stove lengths. Furthermore, they require a long time to dry.

When arranged in a straight line to serve as a fence, the trunk ends of the roots are placed facing the direction of the strongest prevailing winds. In this position the roots rest most securely on the ground and the prongs act as efficient anchors.

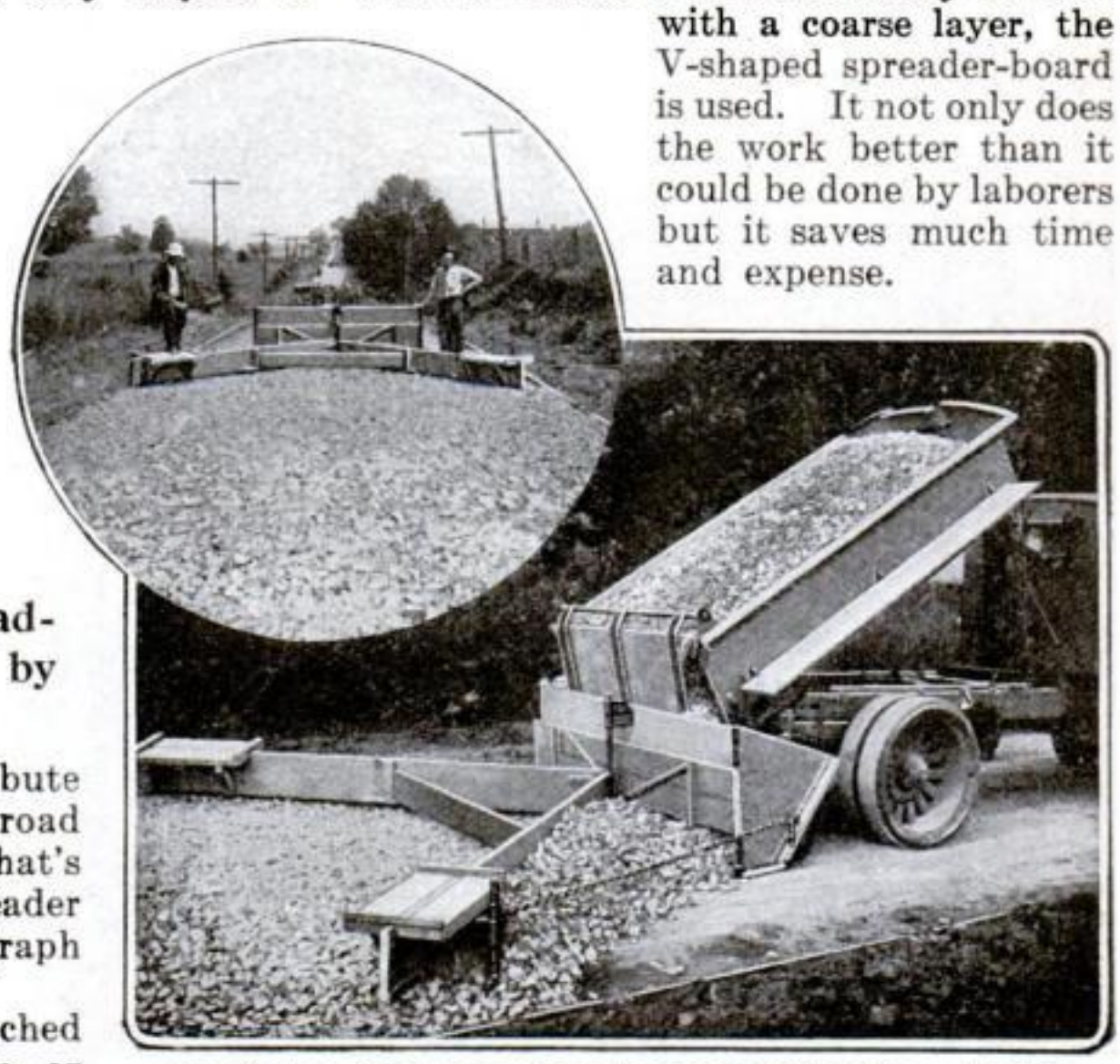
Cost of Placing Roadway Stone Reduced by Simple Spreader

IT'S expensive to distribute crushed stone for road construction work. That's why the simple box-spreader shown in the photograph was invented.

The spreader is attached to any type of wagon or motor truck. The rear gate or opening is set to spread the stone uniformly over any desired width, obviating the necessity of hauling stone from one point to another, either to trim off the high spots or to fill in the depressions. The spreader consists of a box with slanting sides and a rear gate set to any desired opening. The box is attached to the rear end of a wagon or truck, as shown below.

By varying the speed of the vehicle and the size of the opening in the gate, any desired depth of stone is spread automatically without any hand labor.

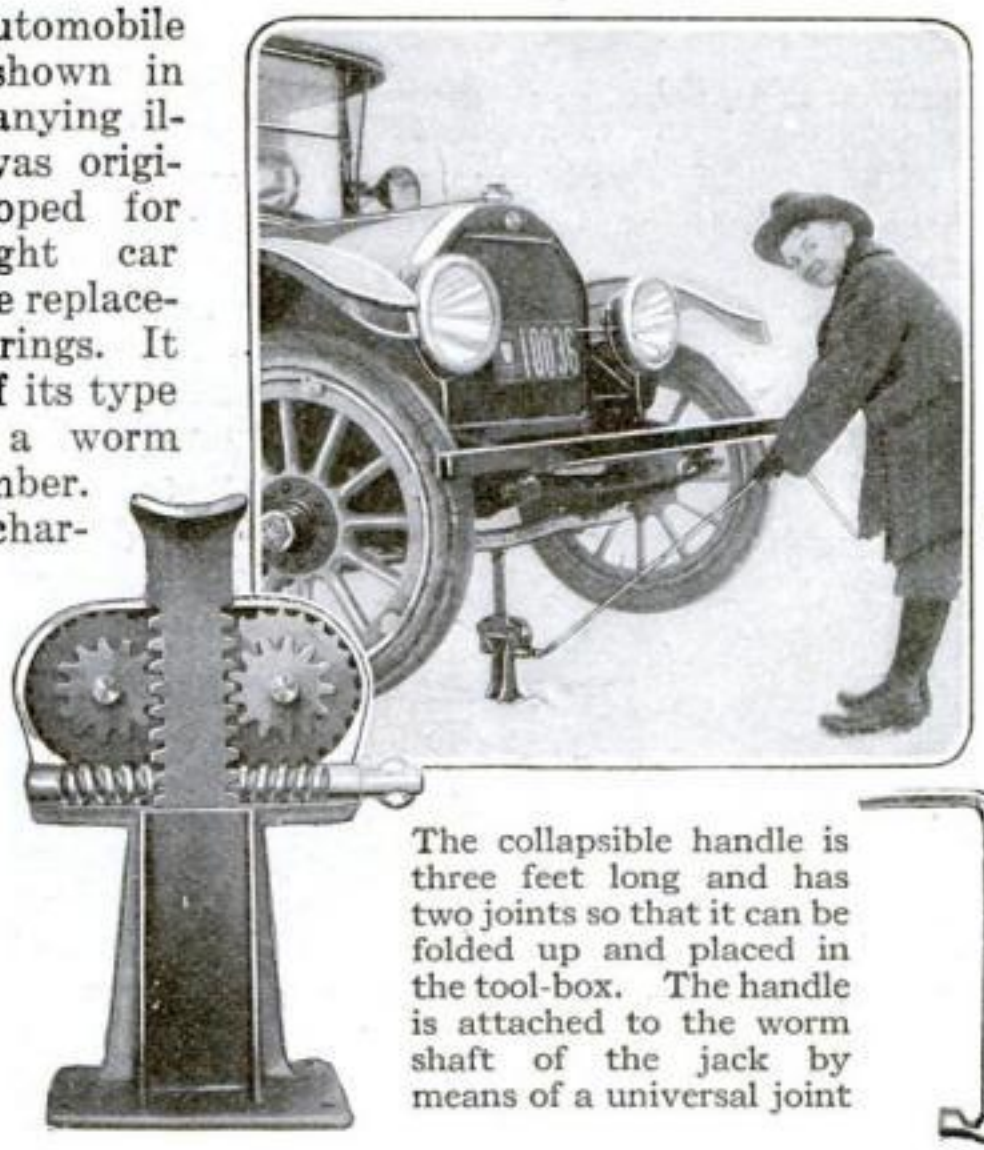
Where the roadway is so narrow that the stone can be spread while the vehicle is running in one direction only, a V-shaped spreader-board may be employed, as shown, to distribute the stone evenly over the entire width of the roadway. When a second and narrower layer of fine stone is wanted on a road already covered with a coarse layer, the V-shaped spreader-board is used. It not only does the work better than it could be done by laborers but it saves much time and expense.



In circle: How the stone is spread uniformly. Above: The spreader used in connection with a motor truck

A Boy Can Lift a Two-ton Car with This Worm-driven Jack

THE automobile jack, shown in the accompanying illustration, was originally developed for lifting freight car trucks for the replacement of bearings. It is the first of its type to employ a worm driving member. The jack is characterized by two main features, the greater and more uniform power application secured through the use of the worm gears instead of ordinary toothed pinions, and a collapsible, universal-ended handle by means of which it may be placed under the car axle so that the car may be lifted without making the operator get out and get under. This is in part made possible by the great power secured through the worm gear and worm wheel reduction.



The collapsible handle is three feet long and has two joints so that it can be folded up and placed in the tool-box. The handle is attached to the worm shaft of the jack by means of a universal joint

The jack has no springs, pawls or ratchets and is operated through only four working parts, a central rack, a set of two worm wheels, two worm gears on the same shaft to drive the wheels and two smaller pinions, placed one on the back of each wheel. Since the worm gears are integral on the same shaft, power is applied evenly to each side of the central rack, giving an easy and uniform lifting motion.

The Dogs Were Hungry and So They Ate the Church

IN the Hudson Bay country, where the dogs are half wolves, a band of these famished animals actually ate up a church. The Eskimo Christians had built a tiny chapel, to hold twenty people. But the poor converts did not long enjoy the little church, of which they were so pathetically proud. The building was of whalebone, an edible substance, and one Sunday, the pagan dogs ate every morsel of the sacred edifice.

The Bag Within the Garbage Can. It's Sanitary and Sensible

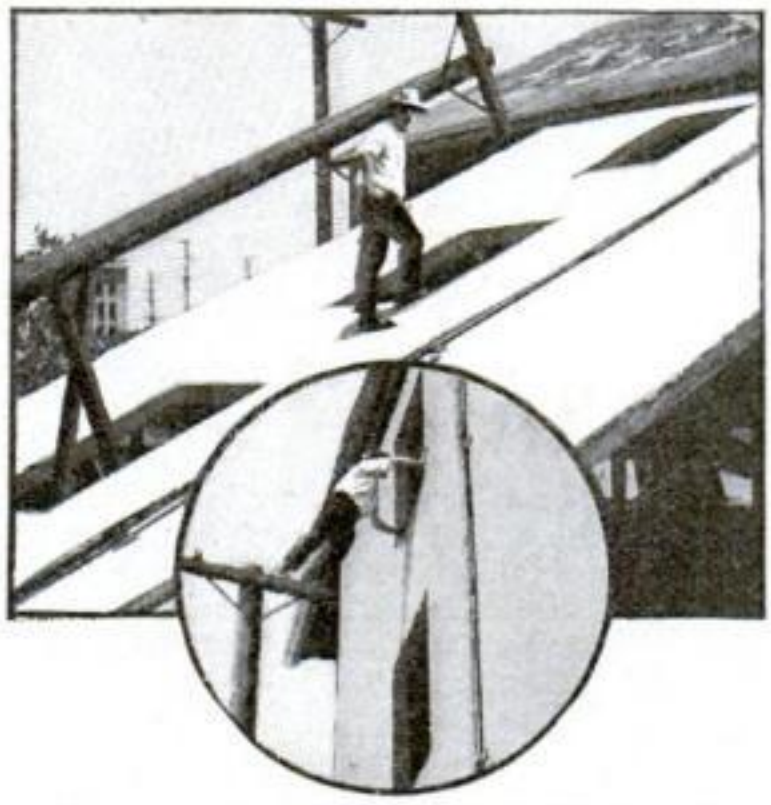
A stout paper bag fits into the street refuse container

A STREET garbage can need no longer be emptied by being lifted bodily, while its unsavory contents are thrown into the uncovered cart.

William M. Walsh, of Grand Rapids, Michigan, has invented a heavy paper bag which fits snugly inside the ordinary metal container. The bag is fitted with a draw string at the top, and after it has been filled, it is closed and removed. No unpleasant odors escape as the bag is being thrown into the wagon. Moreover, the can remains stationary and its surface escapes the unsightly dents and scars which result from too gymnastic handling.

You Can't Fool the Law of Gravity, But the Motion Picture Can

THE photographs shown below illustrate one of the cleverest devices ever invented by the modern magicians of the movies. The upper picture is what we see in the studio—a wall and telegraph pole set up at an angle of forty-five degrees. Suppose that the actor wishes to climb the pole and enter one of the windows. Or suppose he wants to slide from the third story window to the ground. Quite simple, is it not? And it would look just as simple and uninteresting on the screen if the motion picture camera were placed as we should naturally expect it to be placed. But it isn't. That is just where we are deceived. The camera is placed at the foot of the incline and pointed upward along the slope of the wall at a corresponding angle.



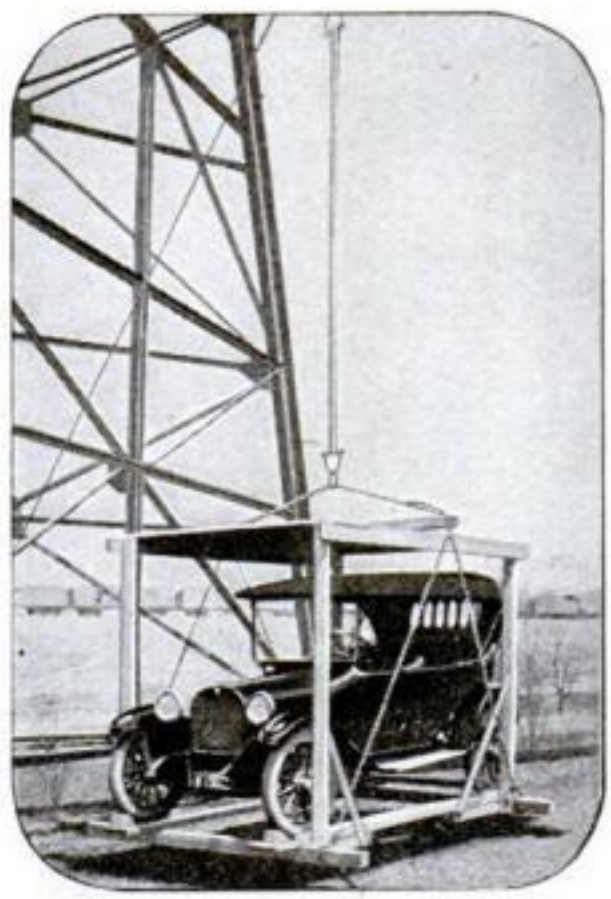
Above: A motion picture climb as it looks in the studio. Below: The identifical climb as it appears on the screen

On the screen we see a perfectly vertical building, with actors climbing straight up from one window to the next, crossing over from telegraph poles and performing the most difficult acrobatic feats. Yet the scene is so convincing that we credit the actors with superhuman powers in spite of manifest impossibilities. In order to get the full effect of this illusion, turn the upper photograph around until the pole is vertical. So long as the law of gravity carries no jail sentence for its violation the picture people don't mind tampering with it photographically.

One Inner Tube More Than Holds Up an Automobile

HOW strong is a rubber tube used in an automobile tire? How far can it be stretched? How much weight can it lift? These were the questions that vexed some tire manufacturers and they straightway set about to find an answer to them. To the layman it would seem as if the ordinary inner tube couldn't be stretched more than from three to four feet, and, judging by the frequency with which tubes burst when they are inflated by careless persons, one might easily believe that they are extremely fragile. Such, however, is not the case.

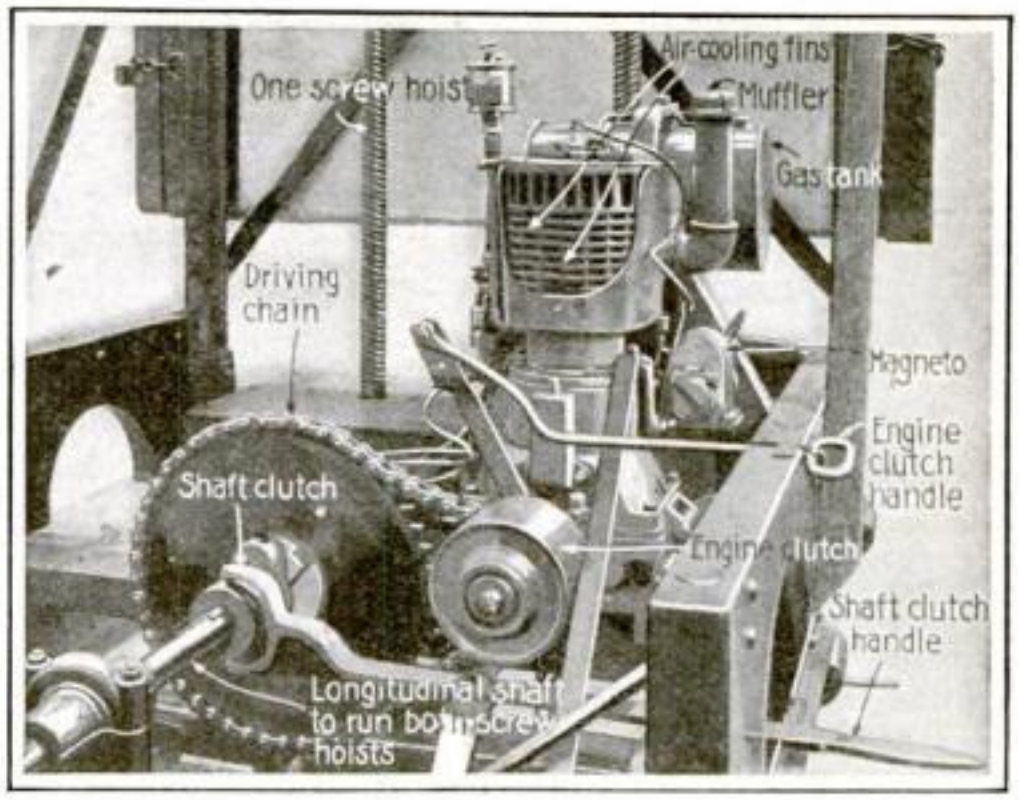
The test which was adopted to prove the resisting qualities of a tube, was a novel and interesting one, as the accompanying illustration shows. An automobile, weighing two thousand four hundred and sixty pounds was encased in a frame, bringing the total weight up to two thousand nine hundred and ninety pounds, and the whole was lifted from the ground by means of a block and tackle so arranged that the entire weight was borne by the tube, which made up the section immediately above the framework. The tube stretched under the combined weight of the automobile and frame until it reached an uncanny length, but it did not break or split. After the test, it resumed its normal shape and under critical examination appeared to be in perfect condition.

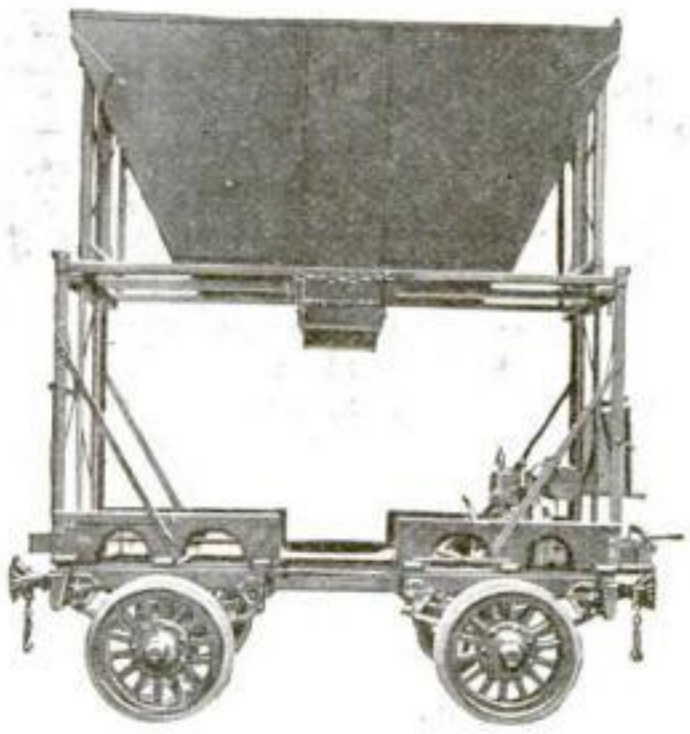


The automobile suspended in mid-air by an inner tube

Little Winston-Salem Is Our Biggest Tobacco Center

ALTHOUGH two hundred miles from the seaboard in North Carolina, Winston-Salem, a dual city of seventeen thousand inhabitants, has been designated as a port of entry by the customs officials, because its imports of sugar, licorice and tobacco are enormous. Since 1910 the manufacture of tobacco products has increased more than three hundred and seventy per cent. Indeed, it is believed that Winston-Salem now leads St. Louis as the chief tobacco manufacturing city in the United States. Eight days after the Government had given Winston-Salem a $250,000 post-office building, the city had paid for it in tobacco revenues.





The longitudinal shaft drives two vertical screw-hoists, one at each end

The body is here shown in its elevated position. It has small side chutes

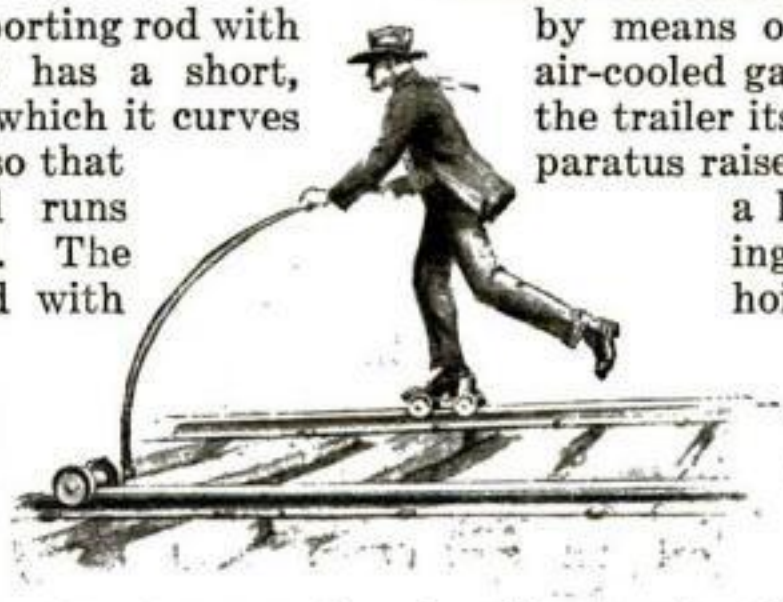
Skating Along a Railroad Track

HOW would you like to skate along a railroad track? You can do it now, thanks to an invention of Dwight B. McNamee, of Heman, Oklahoma.

Mr. McNamee has devised a skate for use along trackways. The four wheels of the skate are provided with hubs which engage with the top of a rail, and with rounded flanges which hold the wheels to the track.

You must use a supporting rod with this skate. The rod has a short, straight handle, from which it curves forward and sideways so that the roller at its end runs along the opposite rail. The roller also is provided with flanges.

Keep the balancing rod ahead of you and you will not be in any danger of falling forward as you propel yourself along with your free foot.



The skate runs along the railroad track. The balancing rod is held ahead of the skater

This Trailer Elevates Its Own Body

DIFFERING from previous forms of elevating trailer bodies, raised and lowered by means of hydraulic, pneumatic or mechanical means operated from the power of the pulling vehicle, the arrangement shown in the accompanying views does not require the truck to stand idle during the loading and unloading periods. Instead, its body can be elevated seven feet in less than one minute by means of a small one-cylinder, air-cooled gasoline engine carried on the trailer itself. This elevating apparatus raises the body by means of a longitudinal shaft driving two vertical screw hoists, one at each end.

The body is designed for carrying coal, earth, sand, gravel or other bulk material. Quick unloading results in maximum efficiency.

Softening Water by Filtering It

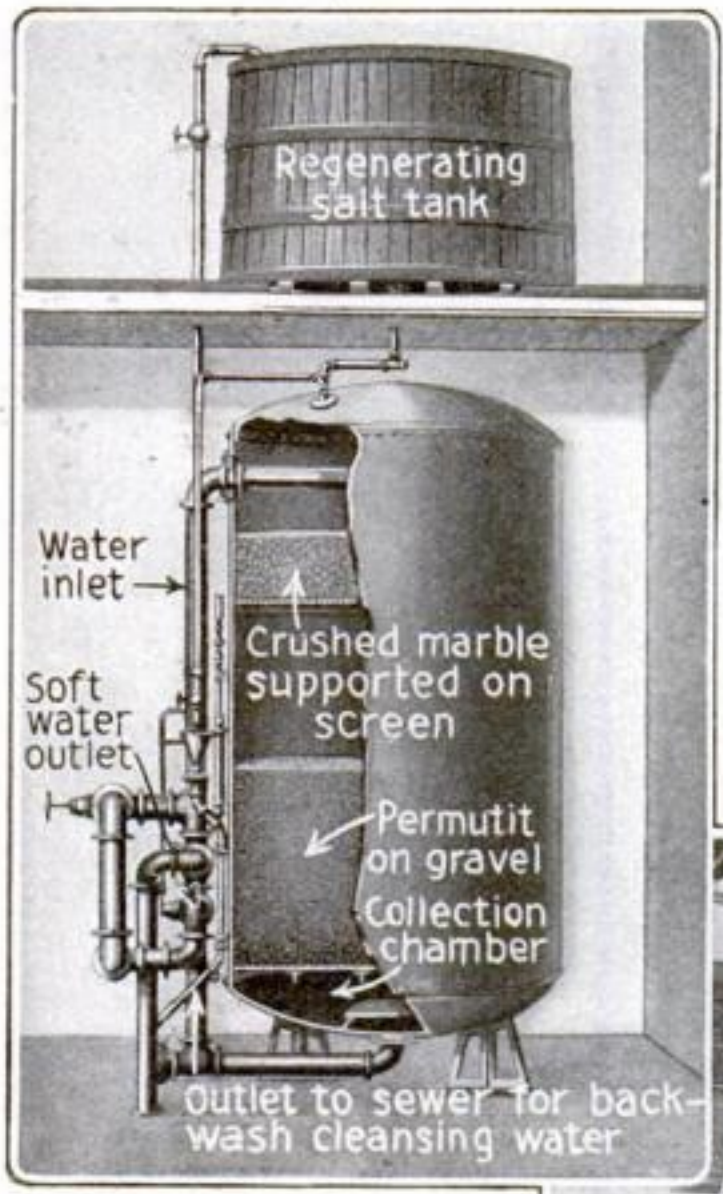
For domestic use a water softener is an absolute necessity to prevent waste

THE production of absolutely soft water (water of zero hardness) is one of the most notable recent achievements of industrial chemistry. A little more than half a century ago two English chemists, Clark and Porter, discovered that the addition of lime and carbonate of soda would reduce the hardness of natural waters. To soften water completely, however, was considered an impossibility, save by distillation. Then came Dr. Robert Gans, a chemist in the service of the German Geological Survey, with the discovery that certain substances in the soil, known as zeolites, had the power of absorbing hardness from water brought in contact with them. Since the capacity of natural zeolites to effect this change was found to be too weak for commercial use, Dr. Gans set about the production of an artificial zeolite which he called Permutit. His artificial product softens the hardest of natural waters. Furthermore it is entirely insoluble and can be used over and over again.

Permutit is essentially a silicate of sodium and aluminum and when hard water, that is, water containing in solution salts of calcium and magnesium, is passed through a filtering medium of this substance, the sodium in the permutit changes place with the calcium and magnesium, which remain in the filter, thus substituting sodium salts for them and softening the hardest natural water.

Permutit is of a granular and flaky texture, very porous, exceedingly tough and possessing a mother-of-pearl lustre. It is made by fusing in definite proportions the minerals, feldspar, kaolin, pearlash and soda. The fused mass is crushed. After the soluble matter is washed out the mass is ready for use.

Permutit can be regenerated when all of its sodium has been exchanged for calcium magnesium. This is accomplished by allowing a solution of ordinary table salt to stand in the filter over night. The calcium and magnesium in the filter are replaced automatically with sodium, and the filter, after a washing of about thirty minutes, is again ready for use. There are filters which have been regenerated nearly three thousand times.



Above: How the water is softened simply by passing it through a filter filled with permutit

At right: A filter which supplies thousands of gallons of soft water a day for industrial purposes

Armless—But Able to Paint Pictures and Signs for All That

IN the little town of Chailey, in England, is a picturesque institution for cripples, known as the Heritage School of Arts and Crafts. Here for many years crippled boys and girls have had a chance to gain health and strength in the open air so that ultimately they could earn their own livelihood.

During the last two years, the school has extended its usefulness by taking in soldiers and sailors disabled in the present war, and re-educating them side by side with the crippled boys. The example of the lads has proven a great inspiration to men handicapped, according to their own conception, beyond hope of ever again being useful.

In one of the accompanying pictures is shown an armless, crippled youth at the Heritage School of Arts and Crafts, painting a tombstone for a favorite pet, buried in the Institution's animal cemetery. The boy holds the brush between his toes which have become almost as agile as fingers and is able to do very creditable work. The second picture shows this same youth teaching an armless child to paint with his feet.

He holds the brush between his toes and is able to produce very creditable signs and pictures

At right: The armless master teaches an armless youngster how to paint with the feet

The monorail car is held on the rail by the ore which it carries in bins on either side

Shipping Ore by Monorail Over a Two-Mile Gap

WITH a gasoline engine furnishing the motive power, a monorail locomotive has been constructed in the Cœur d'Alene mining district of Idaho, to transport ore concentrates to the railroad. It is handling ore at twelve and one-half cents a ton per mile, whereas the old system cost four dollars a ton.

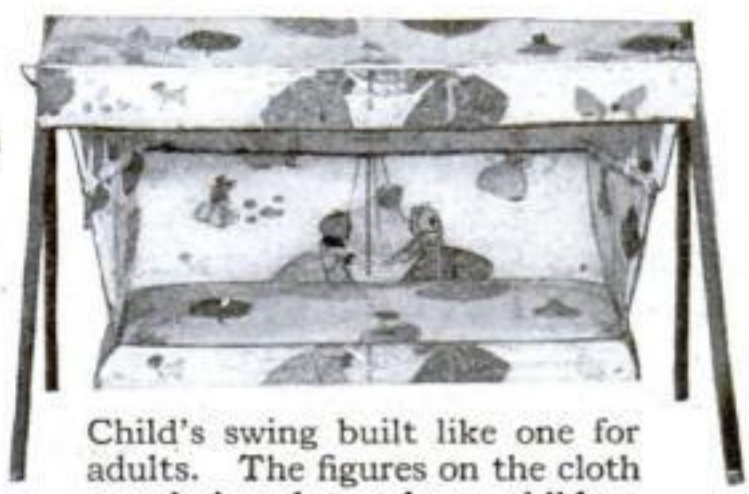
The car, with two double-flanged wheels, runs on a thirty-pound rail, spiked to the top of a heavy beam, while guide wheels on either side help to maintain the equilibrium. The bins hang low on the sides and each one holds a ton and a half of ore. One man constitutes the train crew. The bins are loaded from chutes and are dumped by levers. According to the inventor, H. W. Shepherd of Seattle, Washington, a car similar to that shown, equipped with a converted Ford engine, can be built for $600. The track costs about $2,500 a mile.

Housekeeping Made Easy

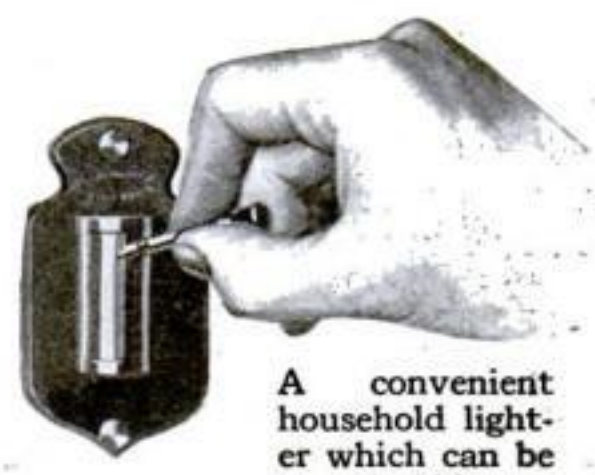
A fancy stand which can be adjusted to hold any length skein of yarn for winding into balls

A shaving mirror with hanger to be attached to an electric light

Imitation tulip placed in a pot. The flower is a twine holder

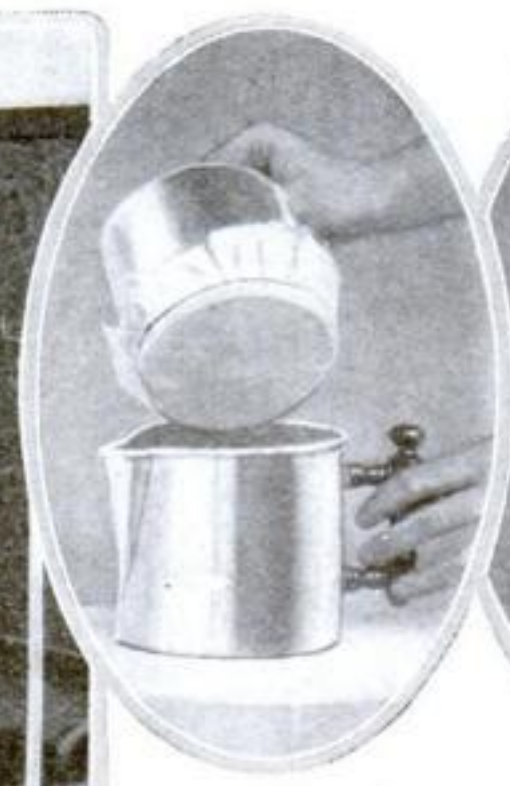


Child's swing built like one for adults. The figures on the cloth are designed to please children



A convenient household lighter which can be used like a match for safely starting a fire

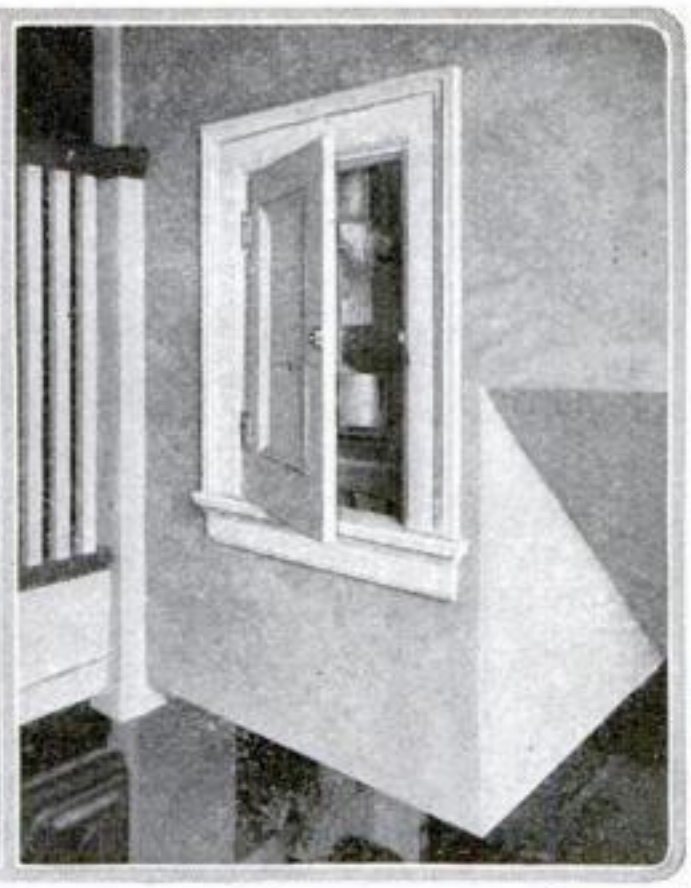
A chiffonier built for baby's little clothes. The top of the chiffonier is used for a dressing stand



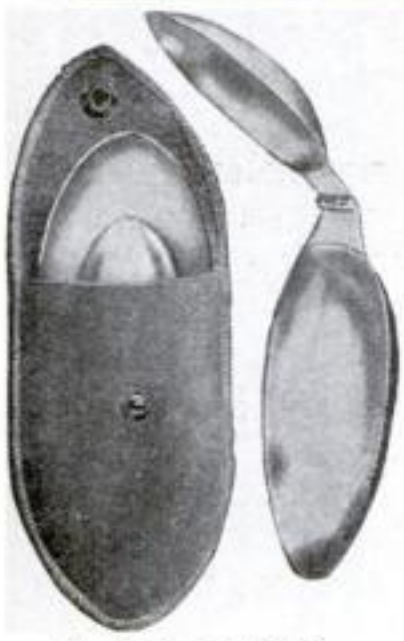
A coffee pot and a percolator combined, in which the coffee may easily be stirred while it is brewing

The palette knife makes an excellent kitchen utensil for removing cookies and cakes from hot baking pans

Housekeeping Made Easy



A high chair seat arrangement that can be taken with baby and used in a restaurant or in an automobile

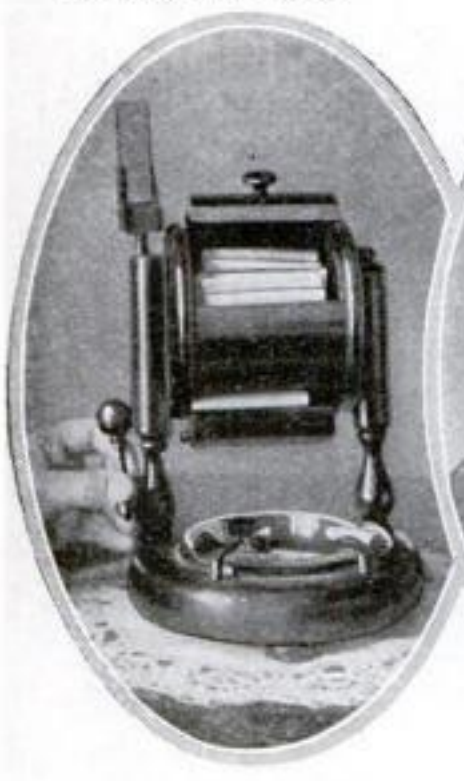


A doctor's folding medicine spoon, and case

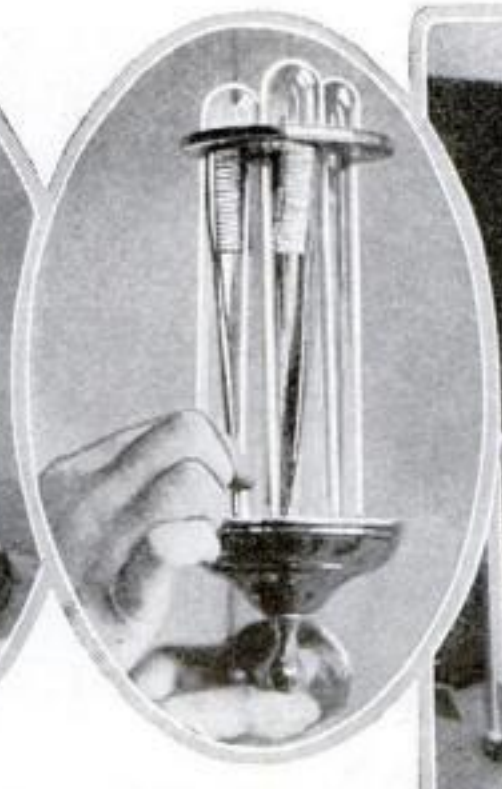
The bottle of this ornamental library drinking set is concealed in the figure

This closet is not for storing pots or pans, but for easy access to the kitchen plumbing

A tall lamp for the seamstress, the standard having a tray for holding buttons, hooks and eyes and other conveniences



Cigarette holder and ash tray. The receptacle holds cigarettes which are delivered one by one



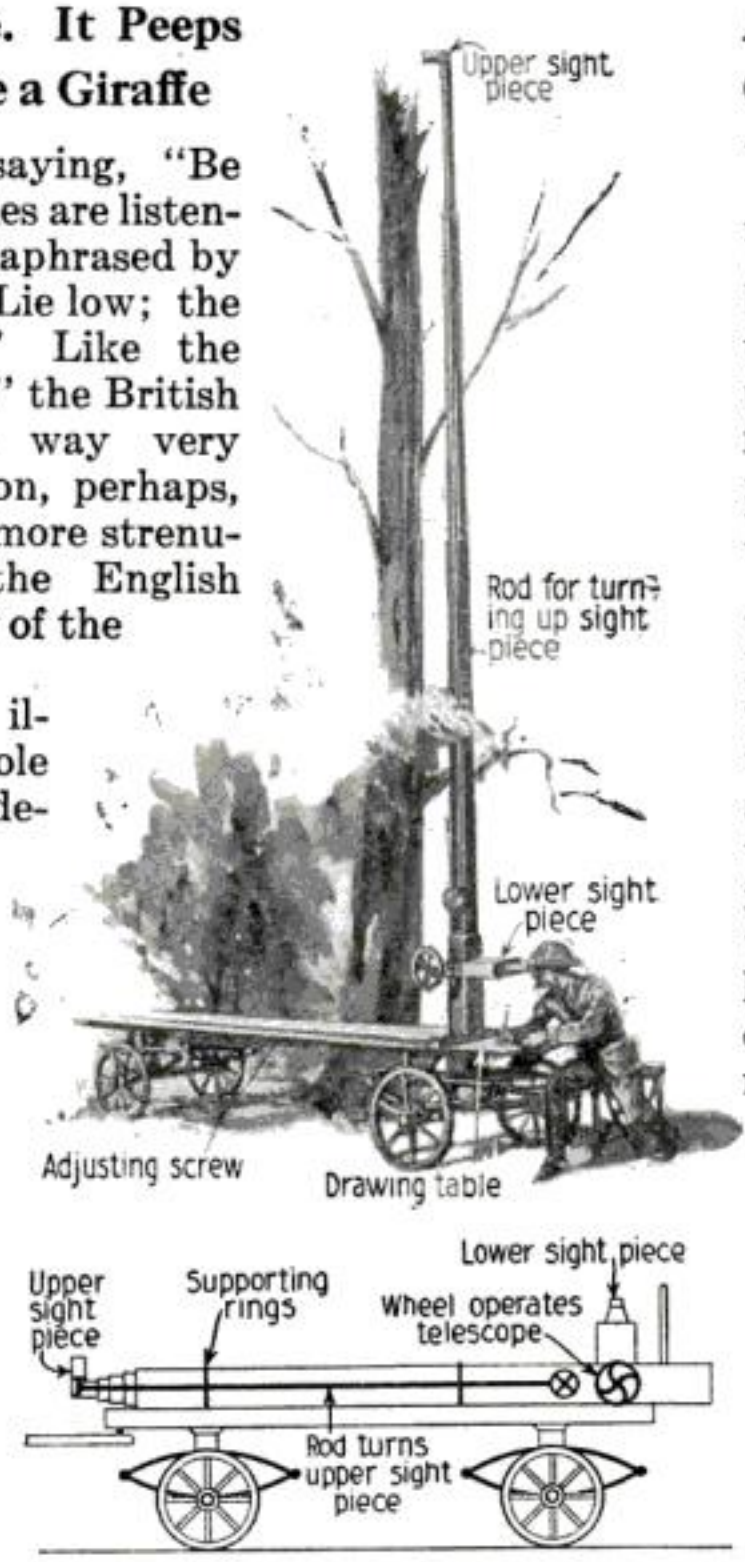
Antiseptic vapor in lower chamber sterilizes the tooth brushes in these individual glass containers

This mattress is made up of eight sections which are connected on one side. It is easy to carry about

The Giant Periscope. It Peeps Over Tree Tops Like a Giraffe

THE old French saying, "Be silent; your enemies are listening!" might well be paraphrased by the Germans to read, "Lie low; the English are looking!" Like the person "from Missouri," the British officer must see his way very clearly. For this reason, perhaps, the periscope is put to more strenuous service among the English troops than among any of the other belligerents.

The accompanying illustrations show a pole periscope of a late design, which is extensively used by the English and also by the Italians, because it enables an officer to peep over tall obstacles, whether mountain peaks or merely tree tops. The height to which it can be run up depends upon the number of sections of which it is made. The sections telescope into the bottom tube when not in use and during transportation, for which a tiny two-wheeled truck is used. The truck is often run up under the protection of a tree, and spikes are nailed in the ground to hold the apparatus close against the tree-trunk. It is the work of but a moment to turn the crank and send the telescoped sections up into the air until the top peeps out over the tree top. In one village on the Somme, a periscope of this kind, set up in a little protected cove, kept the Allied armies informed of every movement of the Germans, who were behind massive entrenchments at that particular spot. The body of the truck is built so low that it can be easily concealed by brush.



The pole periscope in position. It may be folded up in a truck

An Ambulance with Its Own Traveling Kitchen

EACH of the new motorized units of the United States Army Ambulance Corps has its traveling kitchen. These units have taken over the front-line trench work formerly performed by the Red Cross.

The vehicles of each unit consist of twenty Ford ambulances and of two one and one-half-ton trucks to carry baggage and supplies. One of these trucks hauls behind it the traveling kitchen which is mounted on a light four-wheeled trailer on which is carried a field range with all the necessary stew kettles, roast pans and the like to serve three meals a day to the forty-five men comprising a section. The traveling kitchen makes each unit independent of its base for cooked meals, provided its supply of food does not run out. This is an advantage of the greatest importance from the quartermaster's point of view.

An American ambulance with its own traveling kitchen which is mounted on a very light four-wheeled trailer

Killing the Boll-Weevil with a Deadly Gas

EVERY bale of cotton that comes into the United States must first be disinfected before it can be placed on the market. This is necessary because of the boll-weevil and other pests.

The cotton is placed in a steel chamber from which the air is extracted. Hydrocyanic gas fumes, one of the most deadly poisons known, are then introduced. The gas permeates every part of the bale and all living things are immediately killed. The boll-weevil is an undesirable immigrant.

© Underwood and Underwood

The cotton bale is placed in an air-tight steel chamber filled with hydrocyanic gas fumes, which kill all insects

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Driving Eight Hundred and Fifty Rivets a Minute in a Trunk

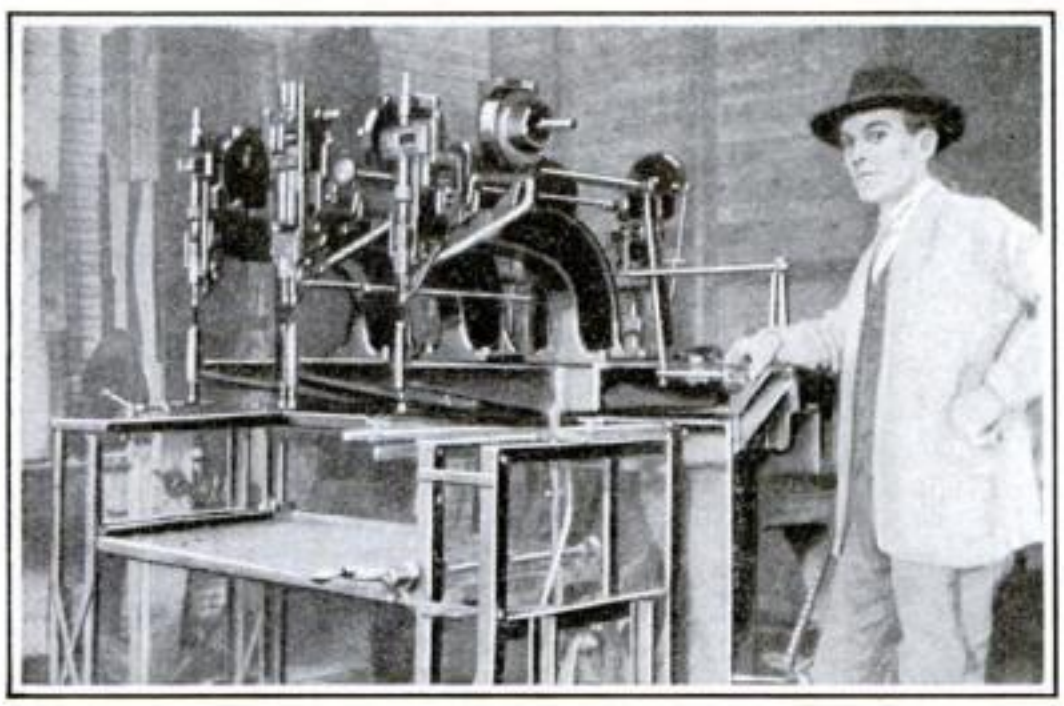
FROM the time he was seventeen years old Thomas Cumming of Grand Rapids was an influential business man, devoting every spare moment to the construction of a machine which would do away with much of the hand labor required in making trunks. Now he steps before the world with the invention here pictured.

The machine is about as high as a man. It occupies a floor space measuring approximately six by six feet. A child can run it and yet it is an intricate piece of mechanism.

An automatic carriage holds the trunk firmly while it moves through the machine. An entire side is completed at one time. The rivets are driven in a straight line, something almost unheard of in trunk-making.

With the old one-man-power machine used in factories, the operator must hold the trunk and drive the rivets at the same time. If he is an expert, he may drive them in line. His speed is from eight to ten per minute. Cumming's invention drives one hundred and eight per minute with each driver, four hundred and thirty-two for the machine.

When handled by an expert it drives a total of more than eight hundred and fifty each minute. Think of it! It does the work of forty to one hundred men. The operator simply places the trunk in position and controls the machine. More drivers can be added if necessary; each increases the speed of the machine by driving one hundred and eight to two hundred and twenty-five rivets per minute.



After twenty-five years of work Thomas Cumming invents the first machine for riveting trunks at high speed

A Lovely View of this Thermometer May Be Had Through a Periscope

SUB-STATION operators are like waterworks engineers—generally with plenty of time on their hands and always devising short-cuts and ingenious devices of one kind and another about their respective domains to do their work with more dispatch. These improvements are of great value in emergencies, not to mention everyday routine.

Here we have an indoor periscope devised by employees at a Walla Walla, Wash., sub-station. It is for the purpose of reading a thermometer high up on the side of a transformer. The line of sight goes from the thermometer to a mirror tilted toward it at the upper end of a metal tube, then down the tube to another mirror which faces the operator. Now the operator need not hustle around to find a stool or a stepladder whenever the thermometer needs reading. It may be said in passing, that thermometers are put on transformers in order that an eye may be kept on the temperature of the insulating oil inside.

A periscope for reading a thermometer high up on the side of a transformer

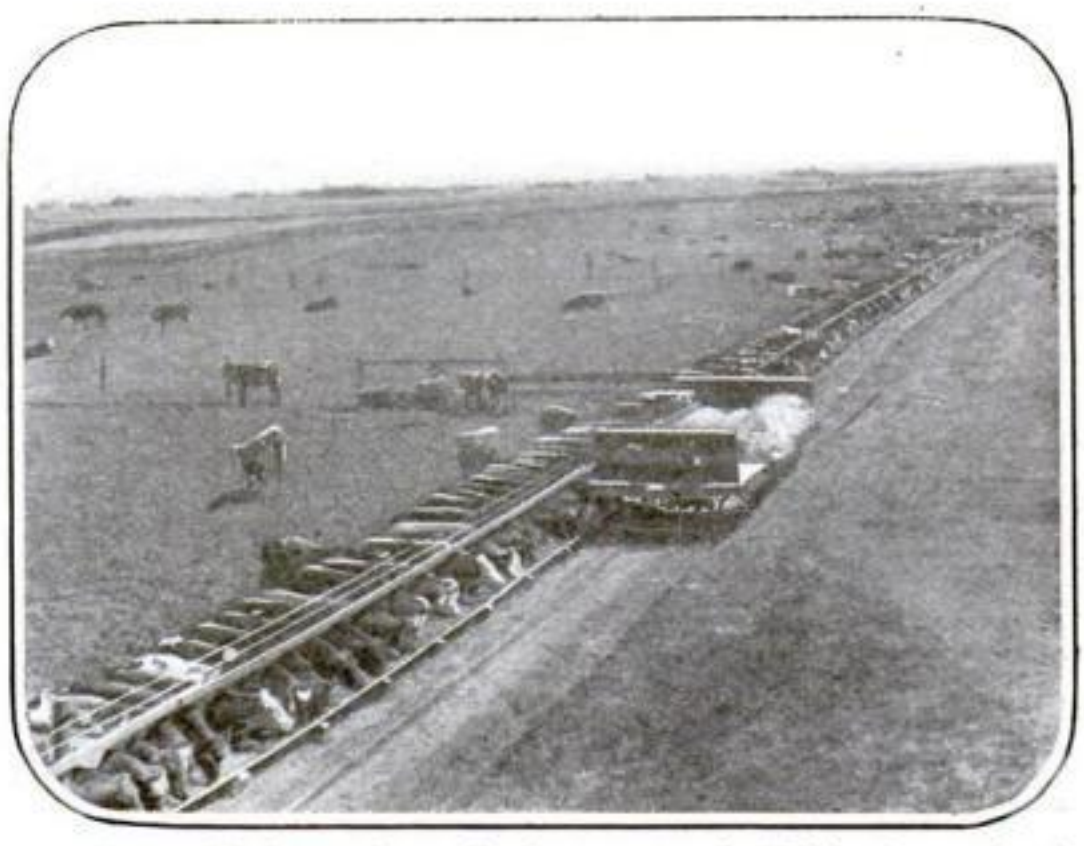
Feeding Cattle from Railway Cars to Fatten Them

THE desert cattle ranchers of Arizona and New Mexico have learned that to raise cattle is one business, and to fatten them is another. For this reason, they ship their cattle to California, where sugar beet pulp is obtained in abundance. One factory is located near the fields where the beets are grown. The cattle are turned into this field after the beets are harvested.

Under the fence is placed a trough which projects outside of the fence just enough to allow the beet pulp to be thrown into it from the cars. The cars run on tracks from the factory to the field and follow the fences around the corral. More space is thus obtained for the beef cattle to feed, and there is but little waste of fodder. In these war days the cattlemen are learning to conserve stock food, as the cattle themselves are conserved for our use.

If Coal Is Too Expensive, Burn Sawdust, as They Do in France

IN some portions of France where coal is so scarce and consequently so expensive that it is altogether unobtainable by the poorer class of people, sawdust is being used as a substitute. The sawdust is rammed down tightly in cylindrical metal boxes, and a few drops of petroleum are poured over it. The fire thus made can be used for cooking and all domestic purposes, and will burn for several hours.

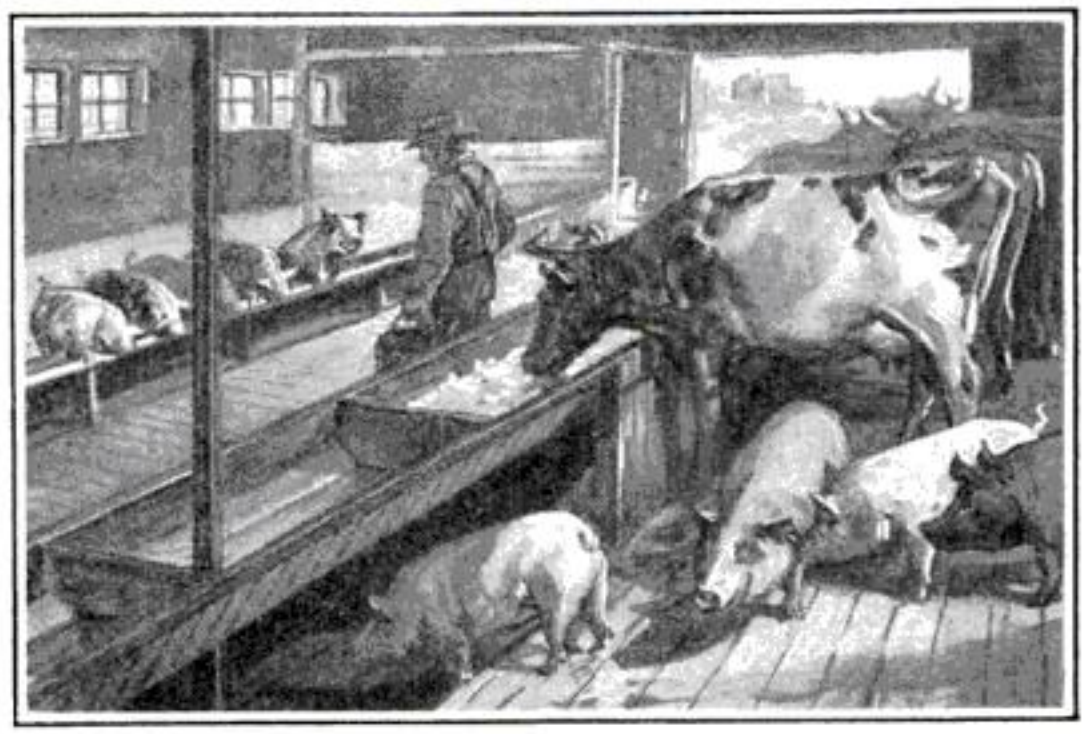


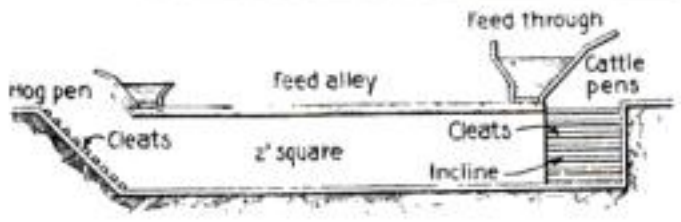
Cars which run from the factory to the fields throw the beet pulp into the troughs which run along the fence

We Fish for the Clam with Dynamite

A CLAM cannot come out of its shell. Its home is on the low sandstone ledges, into which it bores by means of its sharp shell, to a depth of six or eight inches.

The little pholas or boring clam is a great delicacy on the Pacific coast. Its meat is juicy and tender and is excellent in chowder. Consequently, fishermen are not content to dislodge the clams slowly with pick and crowbar. They use dynamite, one blast of which dislodges hundreds of clams.





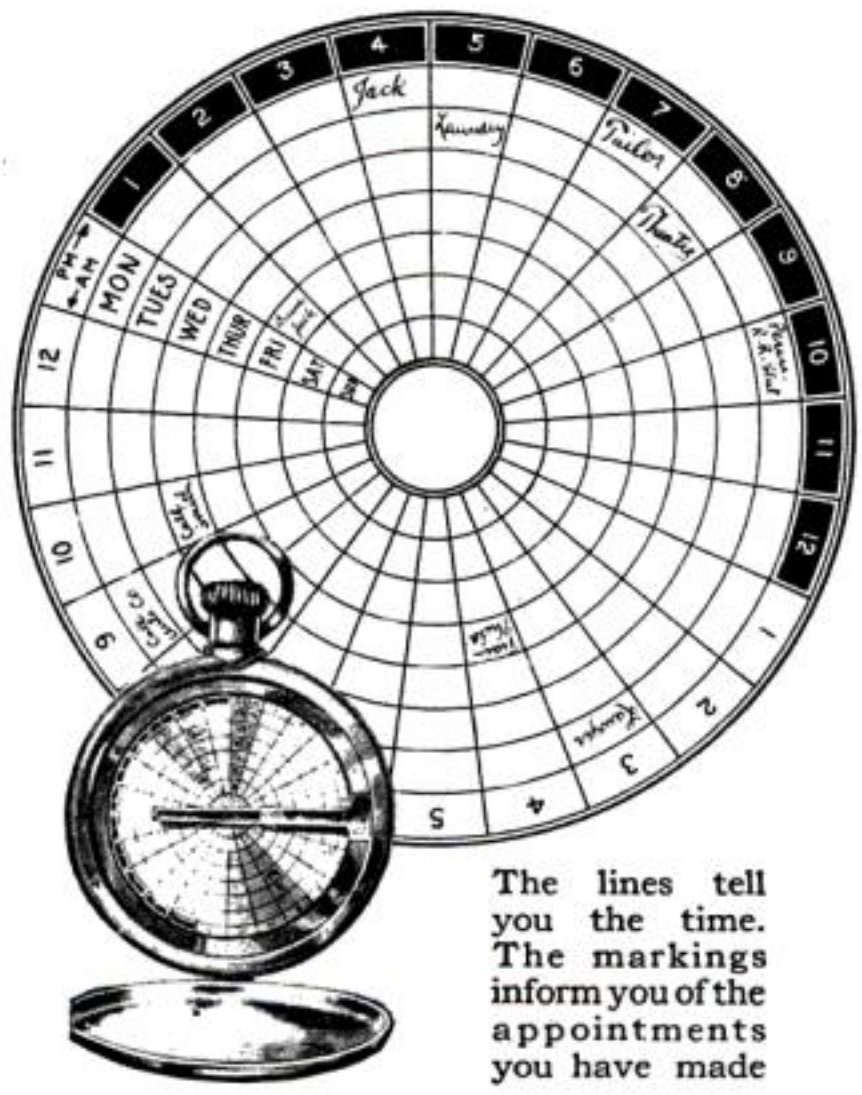
In order not to block the feed alley, the pigs have to go through a subway to reach their own eating troughs

For a Perfect Private Secretary, There's Your Watch

IF you have a thousand things to remember this coming week, let your watch be your secretary. Not your ordinary watch, however, but the one designed by W. F. Tubesing, of Milwaukee, Wisconsin.

A dial, rotating once in twenty-four hours, takes the place of the hour and the minute hands. Seven concentric rings marked upon the dial correspond with the seven days of the week. The radial lines on this dial divide off the hours of the day.

On Monday, a stationary pointer on the watch is extended until it lies over the outermost circle. Early on that morning, you mark within the time lines, the corresponding engagements for the day. Then just glance at your watch and you will be reminded of each appointment in due time.

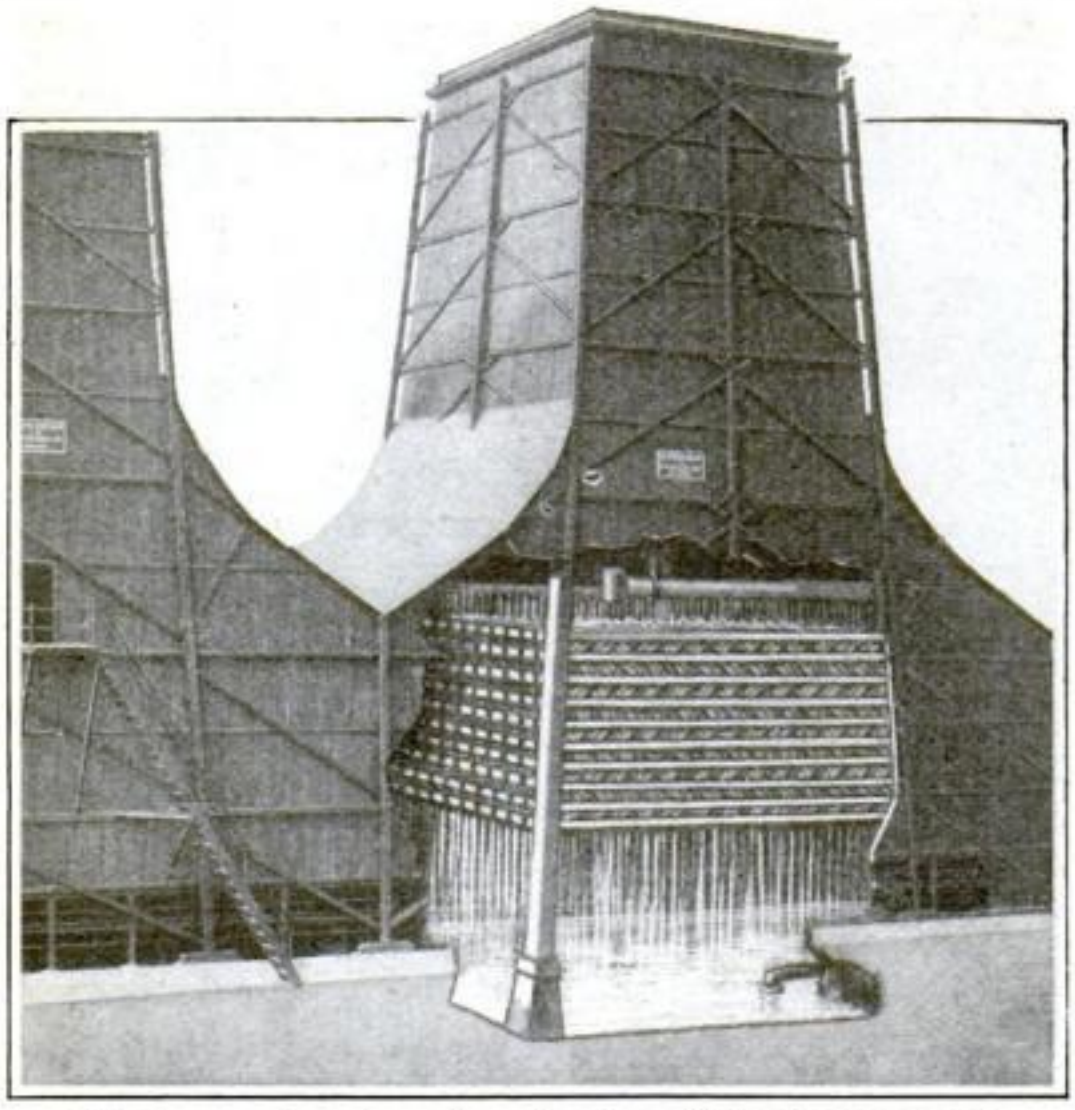


The lines tell you the time. The markings inform you of the appointments you have made

The Pig Subway and Why It Was Invented

THE feeding barn of a Pennsylvania farmer is used to feed cattle on one side and hogs on the other. In going from the "cattle side" of the house, to their own, the hogs had to pass through the alley in which the farm hands served the feed into the different troughs. The hogs would stop in this alley and try to reach the large piles of corn in the bins before continuing on to their pens. Many difficulties would result.

To do away with this loss of time and energy, the pig subway was invented. A small tunnel, about two feet square, was dug under the alley. Now the hogs must go through that. Needless to mention, the pigs didn't take long to adapt themselves to the passage when their "eats" were on the other end.

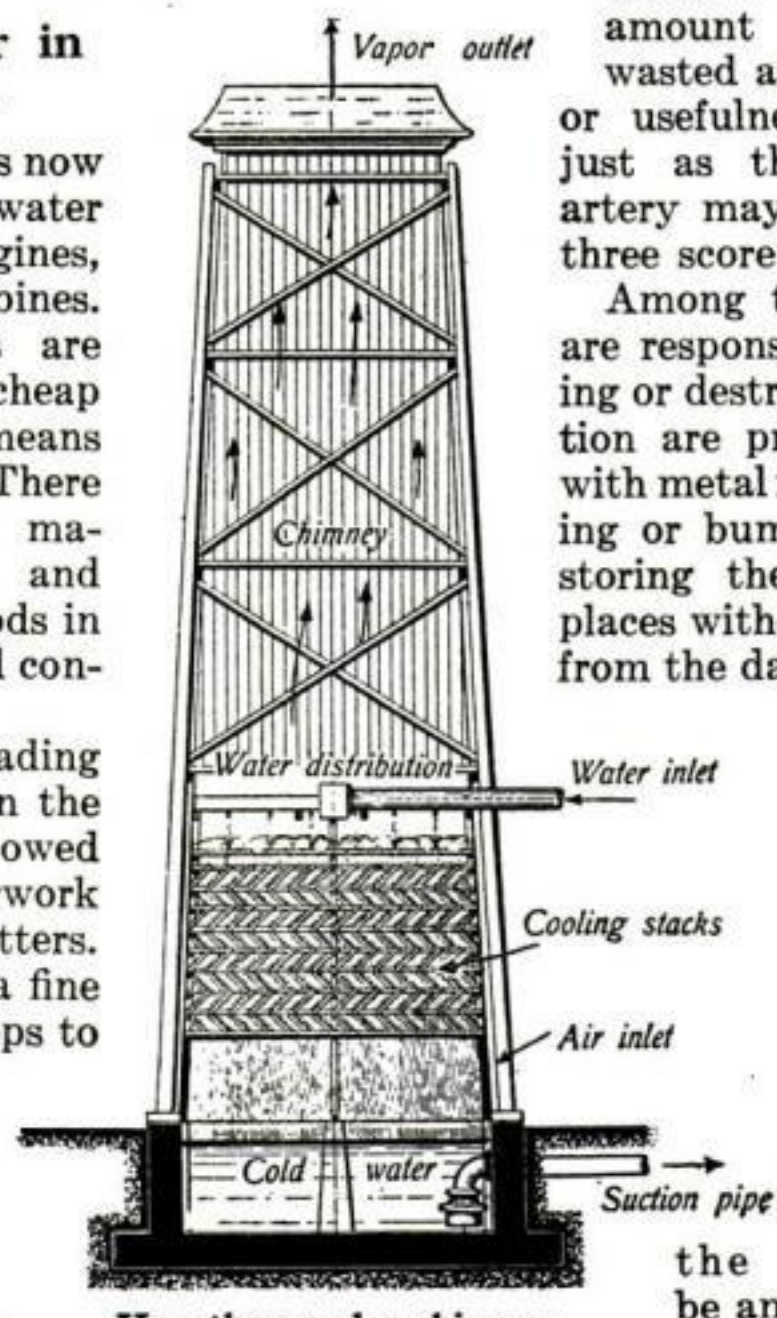


Cold spray dropping down to the cold water sump or reservoir at the extreme bottom of the wooden tower

Cooling Engine Water in Wooden Chimneys

HUGE wooden chimneys now serve to cool the water from powerplant steam engines, especially from stea.. turbines. Usually fans or blowers are installed—but not in these cheap towers. Think what this means in keeping down cost. There are no moving parts of machinery to be inspected and overhauled at regular periods in order to keep them in good condition.

The water is cooled by leading it to a horizontal header in the center, from which it is allowed to drop upon a checkerwork of iron pipes and lateral gutters. Thus it is broken up into a fine spray which ultimately drops to the cold water reservoir at the extreme bottom of the tower. Here the hot water is further cooled by the passage of cold air entering on either side of the tower bottom and forced up and out the top of the tower by natural draft, just as smoke is drawn out of the top of an ordinary brick chimney.



How the wooden chimney works. No expensive fans or blowers are needed

Prolonging the Life of a Motor by Protecting Its Insulation

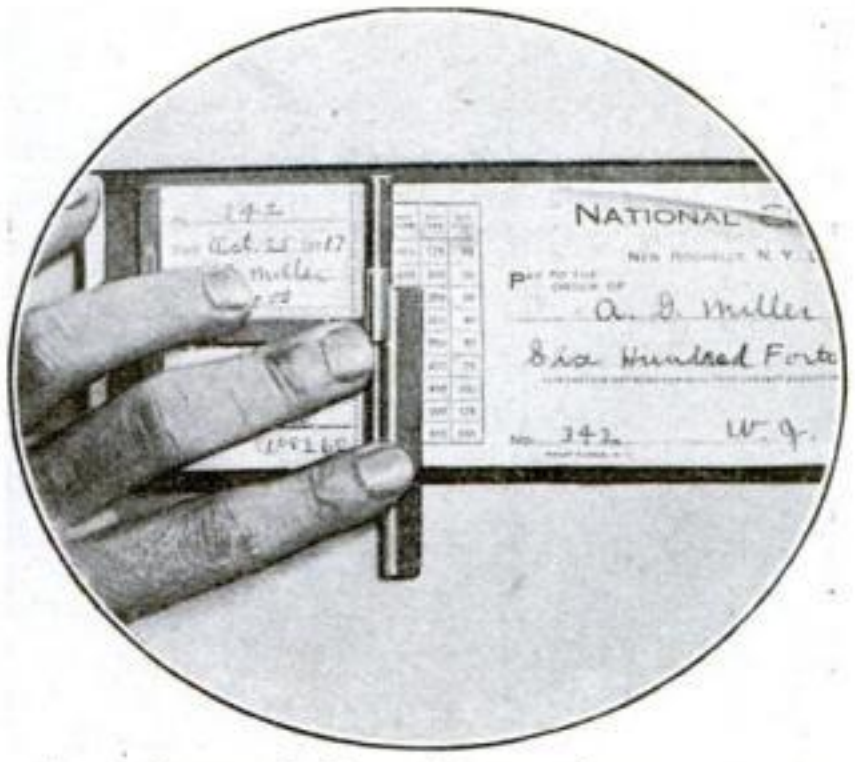
BROADLY speaking, a motor may be divided into two parts—the windings, through which the current flows, and the part into which the current must not be allowed to leak. The windings, which may be called the circulation system of the motor, are analogous to the arteries of the human mechanism, and the insulation to the walls of the arteries. To continue the simile, if the insulation is cut or seriously impaired, there is danger of such an amount of current being wasted as to destroy the life or usefulness of the motor, just as the severing of an artery may cut short a man's three score years and ten.

Among the practices which are responsible for the weakening or destruction of the insulation are prying into windings with metal instruments, pounding or bumping the windings, storing the motors in damp places without protecting them from the dampness, which may proceed from a leak or from escaping steam, or placing them in an atmosphere laden with acid fumes or minute flying particles of metal.

Periodic attention to the insulation as well as to the other parts of the mechanism will be amply repaid. Accessible parts should frequently be wiped clean.

This Device Protects Your Check From the Forger

A CHECK book cover provided with a protecting device which makes it impossible for a man to raise a check, has been placed on the market. Various amounts up to one thousand dollars are stamped on the check near the row of perforations where it is detached from the stub. The protector is permanently attached to the leather cover of the check book, and it can be quickly adjusted for any of the three columns of figures. A sliding straightedge is moved either up or down to the correct figure. The protector is pressed fast and the check torn from its stub.



Tear off your check, and the maximum amount appearing at the left is your protection

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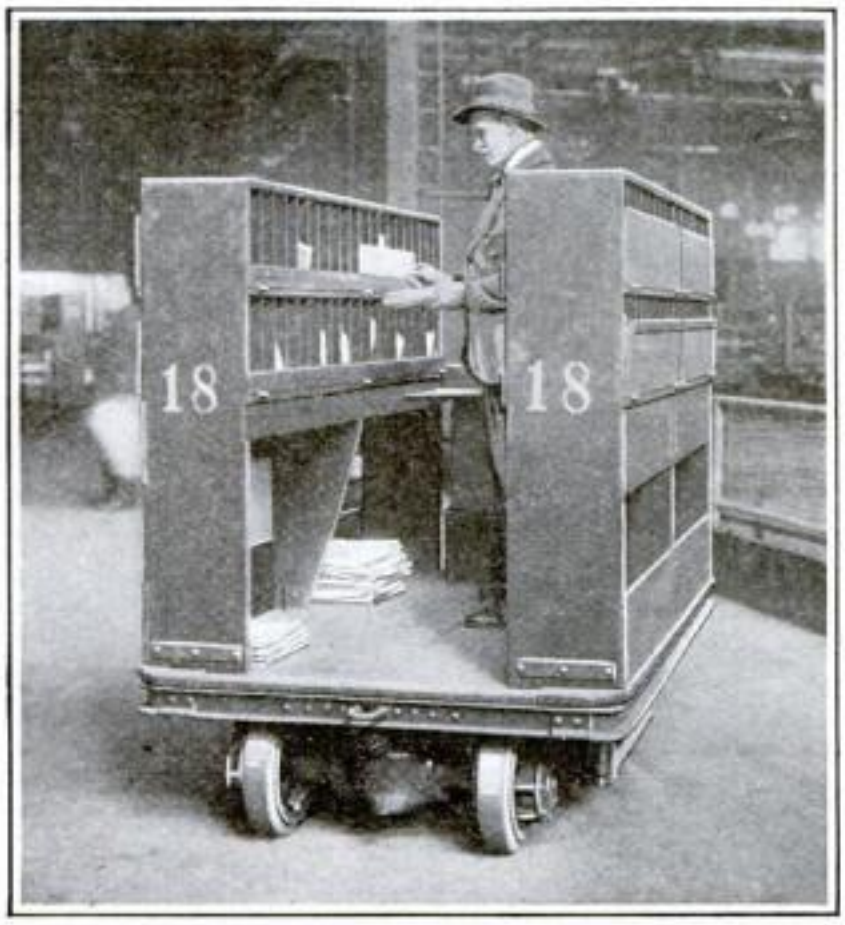
The Electric Stevedore Distributes the Mail

THE mail of the various departments of a big manufacturing plant in East Pittsburg is delivered by an electric truck, of the type commonly known as "the electric stevedore." On the flat body of the little truck is mounted a sorting table which has eighty pigeonholes, which occupy shelves on both sides of the vehicle. The mail is sorted while the car is running, and the saving of time is about fifty per cent over the former method.

Mail is collected from the various departments by the same vehicle, and large packages, which formerly would have been delivered by a special messenger, are stored beneath the pigeon holes on the floor of the car.

A driver and a clerk go with each truck. Six complete trips a day are made. The extent of the plant can be estimated from the fact that each trip requires at least an hour, and sometimes an hour and a half, depending on the quantity of mail to be distributed, and the congestion of the aisles. The deliveries are all made under one roof although over two floors.

This system takes the place of pneumatic tubes, through which bulky pieces of mail could not be sent.



A specially fitted truck takes the place of a pneumatic tube system for distributing mail

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How Cutting Tools Are Doing Their Bit

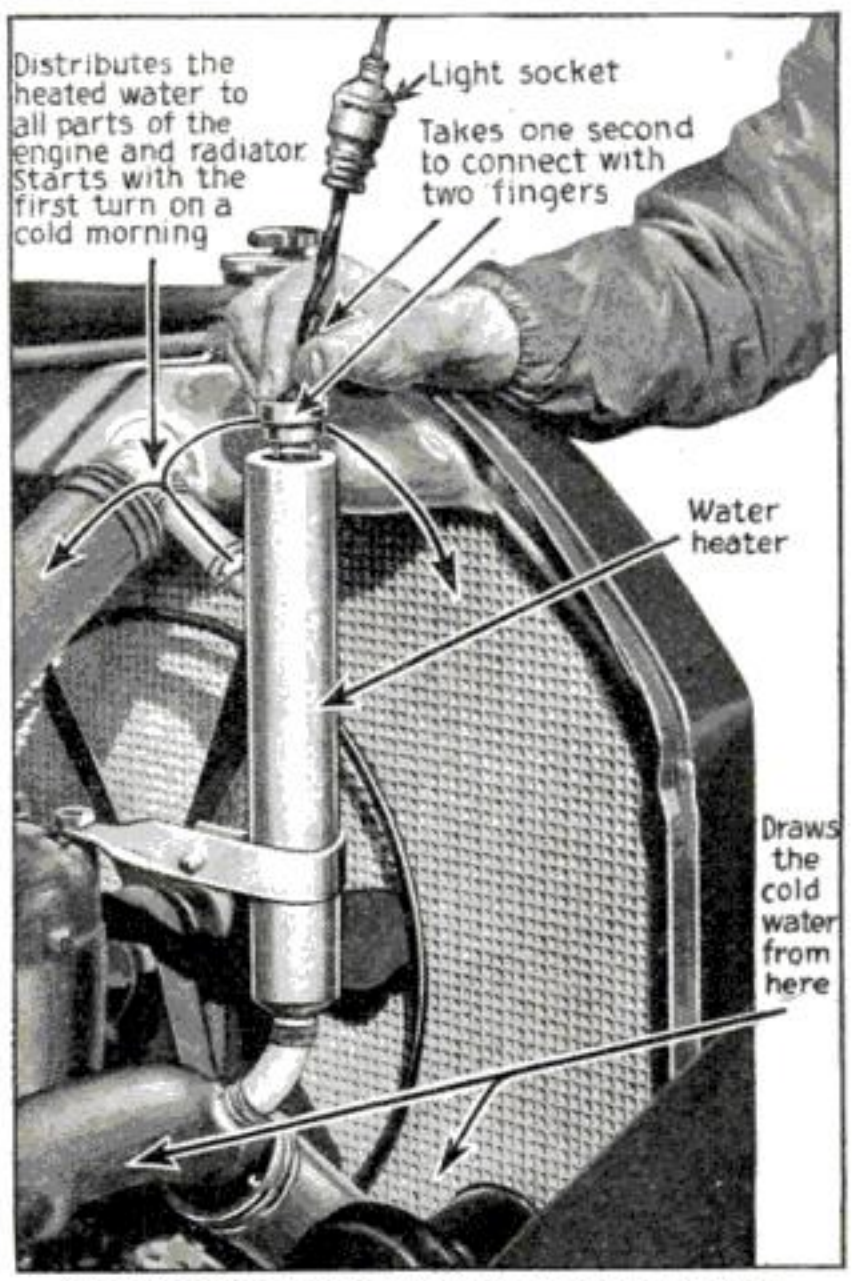
ANY manufacturer who is turning out tools is as important to the Government as if he were making munitions.

Nine hundred and ninety-seven cutting tools alone are required in manufacturing a modern rifle. The twist drill is one of the busiest of these. To supply a million rifles, ninety-four million holes must be drilled.

Shrapnel, torpedoes, machine guns, biplanes, motor trucks and anti-aircraft guns require from seventy to five thousand holes each.

Keeping the Radiator Water Warm During Freezing Weather

A NEW electric arrangement for preventing the water in automobile radiators from freezing, has been invented by Philip Apfel. An electric-heating element is attached to the radiator by-pass under the hood. The insertion of a plug connected with any lamp socket, insures the supply of current. A thermostat in the circuit turns on the current when the temperature falls below the freezing point. Should the heating plant of the garage go out during the night, your radiator water would be warm in the morning. In fact, you could adjust the thermostat to keep the water at sixty degrees, so as always to be able to start the engine at once.



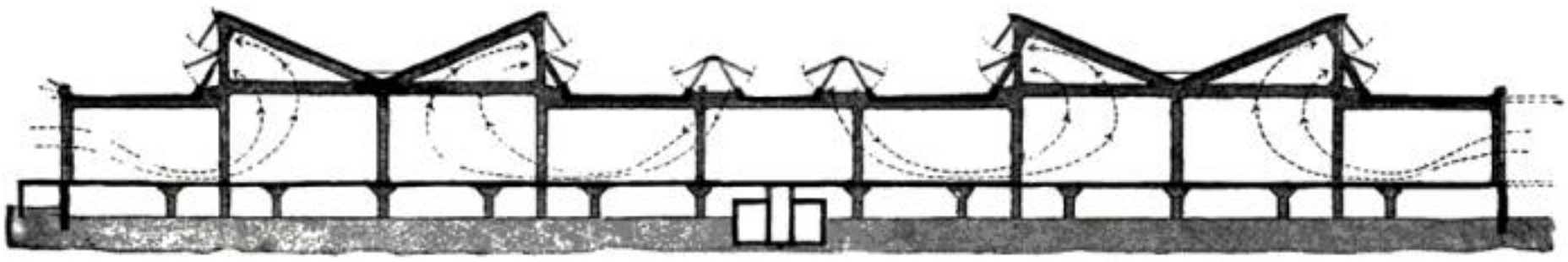
The electric heater warms up the radiator whereupon the water begins to circulate

Ventilating a Huge Building Covering Forty Acres

MANUFACTURERS are realizing, as never before, that light and air have a profound physical influence on the working man. Accordingly, old factory buildings, generally poorly ventilated, and practically windowless, are being supplanted by the modern building with glass top and sides. The accompanying illustration gives a vivid idea of the new light and air principle of construction.

Covering forty acres, this giant building is as perfectly ventilated and lighted as if it had no walls or roof. The central portion of the roof is inverted like two great wings, whose slope deflects heated air to the outlets. The air comes in through low intakes and goes out through raised outlets in a way that causes natural changes. Chilling down-drafts are prevented by the truss roofs which force the ascending currents strongly toward the outlets. Forced ventilation is not resorted to unless a building is so huge that the ordinary methods of natural ventilations can not be successfully applied.

In the new system, light is abundantly and evenly diffused. There are no dark corners anywhere about the premises. The under sides of the inverted roof are painted white, thereby utilizing by reflection, light which is lost with the ordinary roof design. This system was first designed for foundries and forge shops. The escape of heat is hastened by locating the cupolas, molds, furnaces and rolls under the outlets, so that heated air and gases go straight out.



Two frames in the center admit light and air, and two others admit light and discharge air. This arrangement prevents any chilling down-drafts and insures a natural change of air

"Transfer, Please," Is Answered by An Automatic Machine

AN inventor has taken out patents on an automatic transfer issuing machine that can deliver transfers at the rate of sixty per minute.

On top of his machine are a number of individual buttons which represent either intersecting car lines or other transfer points. By pressing one of these buttons and operating a foot lever, the proper transfer is delivered. It is punched with the month, day, hour and line to which it is issued.

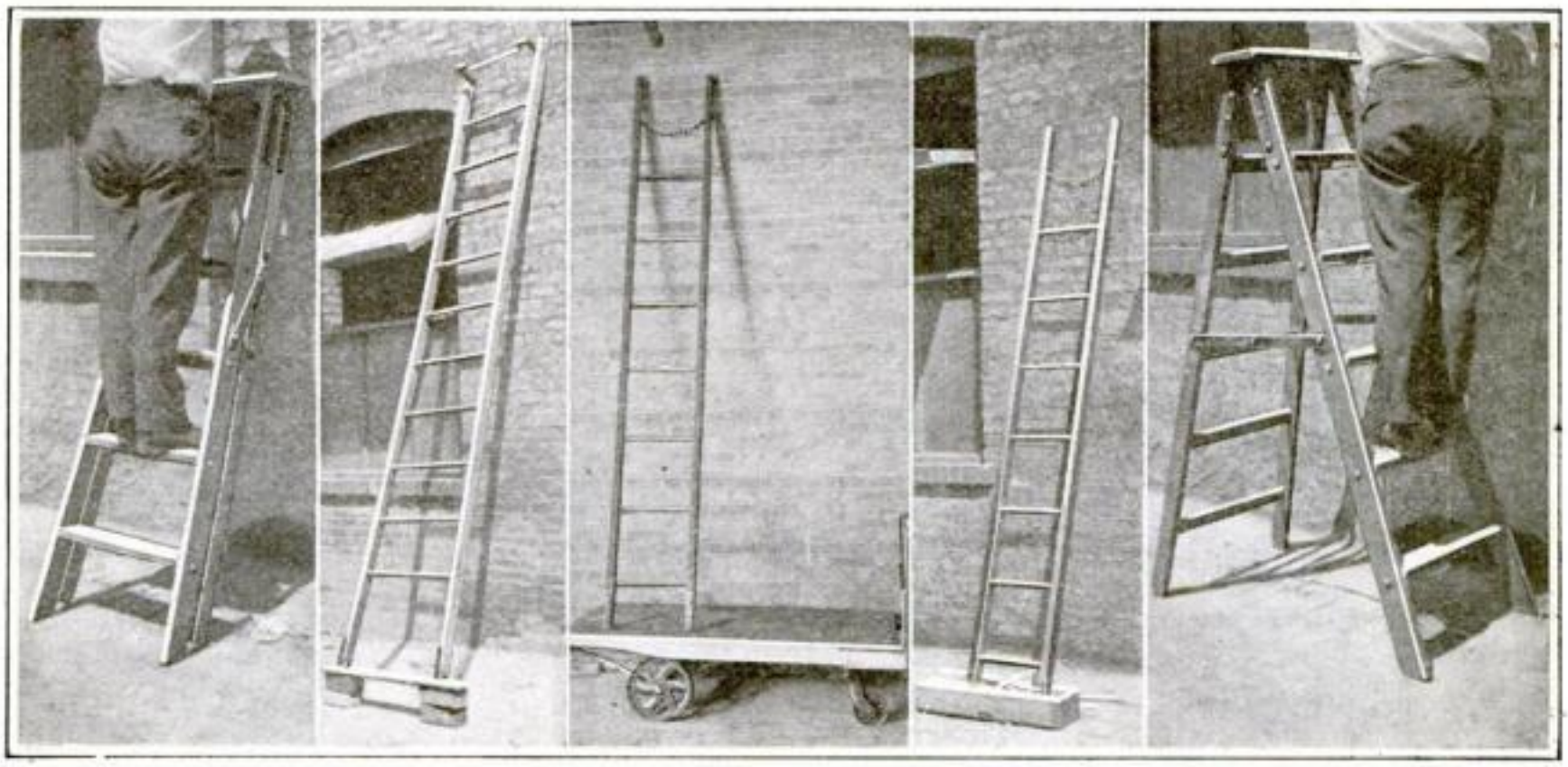
The transfers are supplied in small rolls of five hundred or a thousand. As each transfer is issued, it is recorded by the machine, so that the auditing department always has an accurate check on the conductor.

This machine issues transfers at the rate of sixty a minute and records the number issued

Use Your Ladder Properly and Avoid an Accident

LIKE all other accidents, those caused by ladders are divided into two classes: those due to unsafe equipment and those caused by unsafe practices. Look at the accompanying photographs and you will see some very common causes of ladder accidents. How often have you misused your ladder in one of these ways?

There are means by which you can safeguard the base of your portable ladder. Metal points, lead-coated plates and carborundum have been found to serve very well. The state of Pennsylvania goes so far as to make it a legal obligation to have a man at the foot of each ladder when the floor is of iron. Pivoted lead shoes are recommended for concrete floors and rubber bases for wet floors.



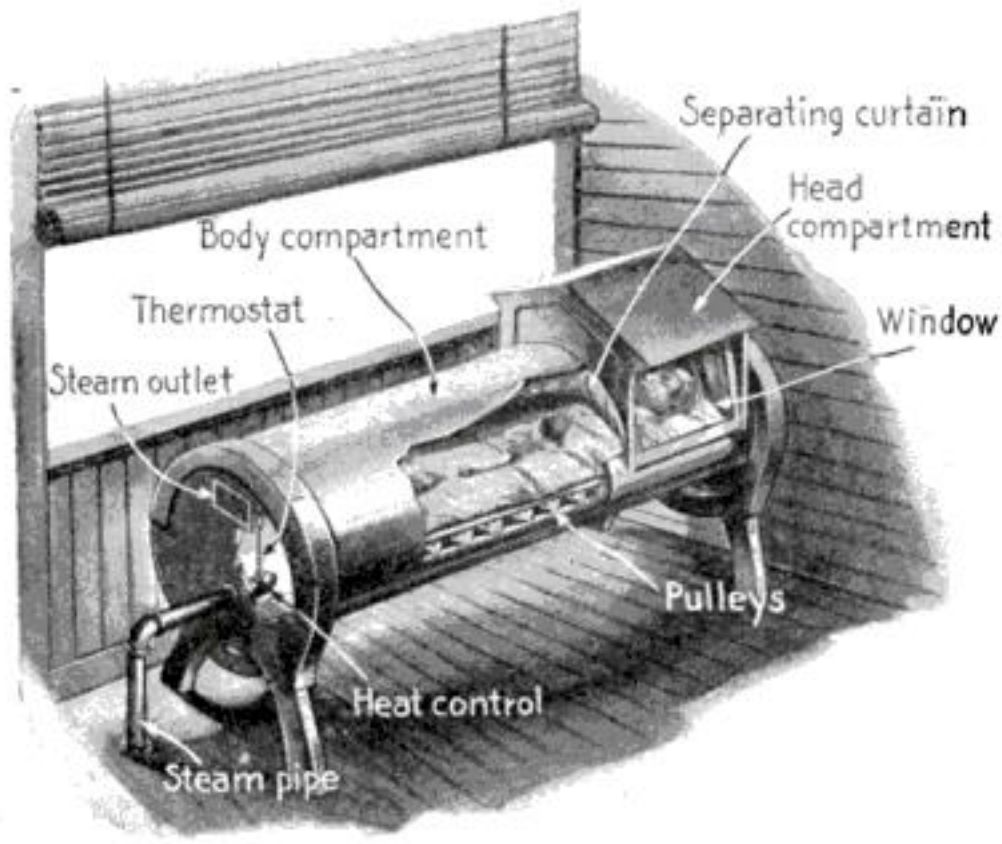
Have you misused your stepladder in one of these ways? To use a half opened ladder, a ladder elevated on bricks or one placed on a movable platform, is to court sure disaster

Can Yourself for the Night and Turn On the Heat

GOING to bed will soon be the most difficult and dreaded of the day's tasks if the inventors are allowed to have their way. One of them, James E. Hanger, of Washington, D. C., has evidently forgotten all about the adage that a hard day's work will put feathers in any old bed. He has devised a queer contraption which for exterior appearances at least appears to be a cross between a houseboat and a silo.

Imagine yourself lying in his bed, with your head under the house-like structure at one end and your feet under the ventilator at the other end. You are in the same position as a piece of canned asparagus. There is, however, at least a slight difference. Your head is literally cut off from the rest of your body by a cloth partition which prevents the air from reaching that part of the body below the shoulders. Dormer windows enable the sleeper to obtain as much air as he wishes through the house structure, but from the shoulders down, artificial heat is admitted into the can through a pipe joined to the foot.

The semi-cylindrical part of the bed can be moved back and forth as the occupant wishes. Instead of the ordinary mattress, cords are stretched between pulleys made fast to the sides, so that the bed may sag as much as one wishes. The inventor says his device is particularly fitted for invalids.



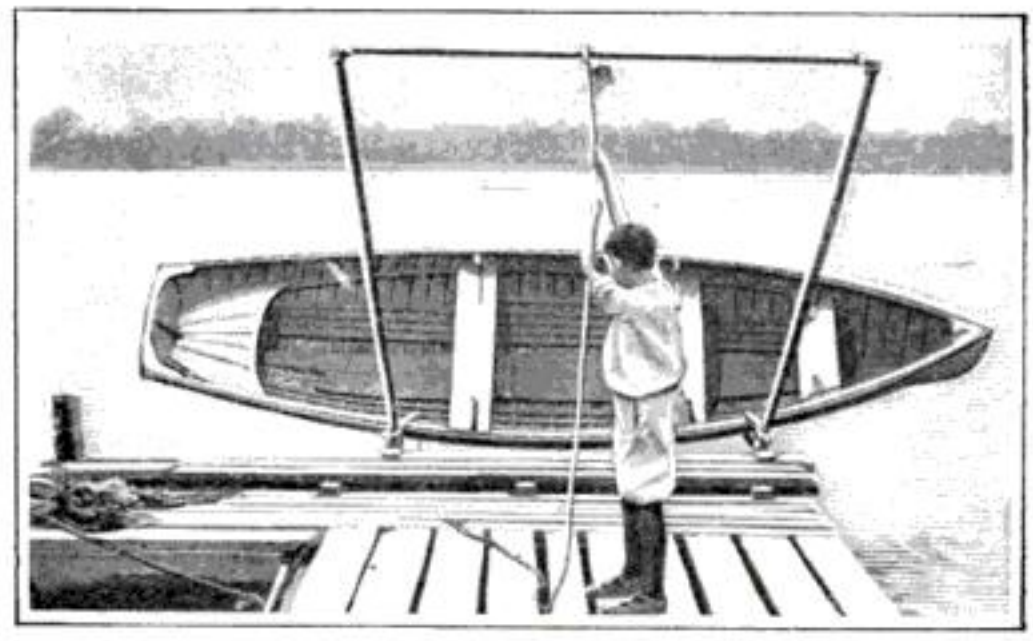
To sleep comfortably, emulate the ground hog and crawl into your can-bed. Dormer windows admit air

Lifting a Rowboat Out of the Water by a Twist of a Lever

ORDINARILY, to raise a boat out of the water and place it upon a float, two men lift one end and drag the boat about half its length over the edge of the pier. Then, with the float serving as a fulcrum and the boat as a lever, the other end is raised and dragged up.

The one-man boat-raising device which Harry Houghton of Seville, Ohio, invented, consists of a lever-acting frame, a portion of which extends below the water line and and under the boat. By means of a lever, fulcrumed to the frame, the boat is tilted up so that the water in it is dumped out as the boat is raised.

The operation of the lever is plainly shown in the accompanying photograph, in which a small boy is seen doing what formerly required the services of two men. The wear and tear on the boat have been eliminated.



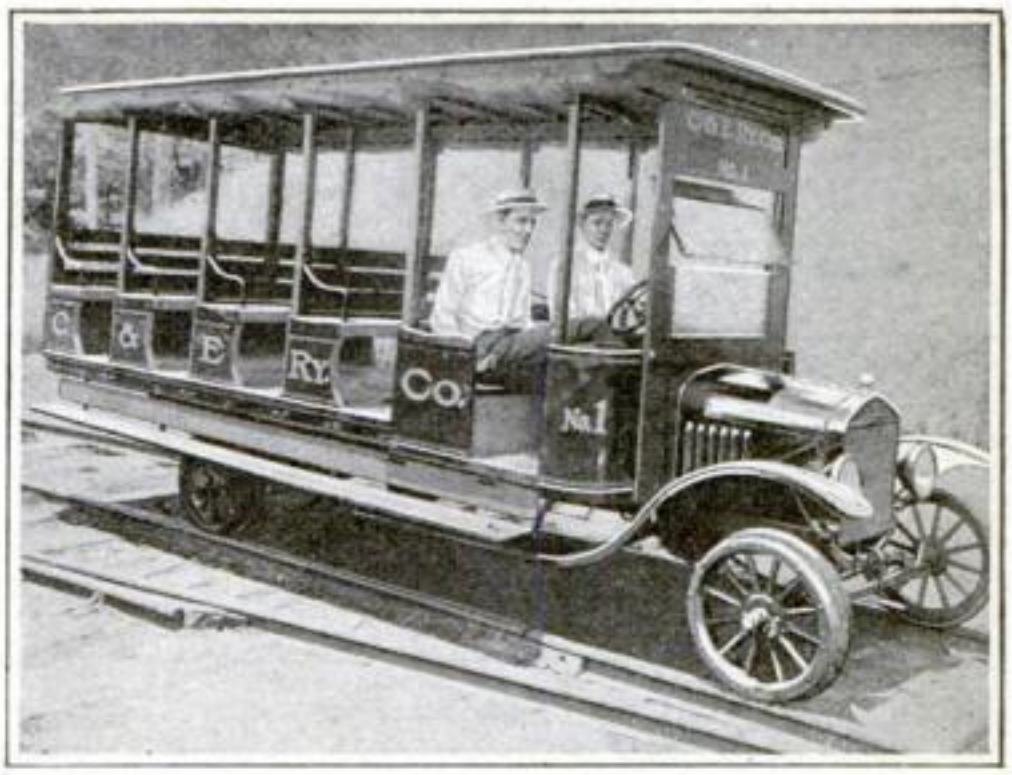
By means of this lever-acting frame, even a small boy can haul a heavy rowboat out of the water

Setting President Wilson's Portrait in Type

HARVEY PARSONS is a cartoonist on the staff of a Topeka newspaper. He conceived the original idea of setting up President's Wilson's reply to the Pope in type, in such a way that the result would be not only a readable reproduction of the message itself, but a portrait of President Wilson.

First of all, Parsons drew a likeness of the President. With that before him, he gave minute instructions to O. W. Kelly, an old printer friend of his. Parsons does not know Nonpareil from upper case Roman; yet he was able to make Kelly understand what was wanted. After his successful experiment, the artist declared that he could write instructions to a printer which would read: "Set a yard of the old Testament in 8-point Gothic as per . . ." with a string of symbols and figures. And what would be the result? A type portrait of Moses! And the printer would not know it until he had pulled his proof.

As our illustration shows, light-faced type composes the high lights of the picture, and black or bold-faced, the half-tones and darker portions. The proper spacing of the letters is not destroyed, and the reply to the Pope is legible in spite of the underlying likeness. The portraits are set in type by machine.



A railway car which looks like an automobile and is controlled like one, but which runs on an ordinary track

What is It—Jitney or Railway Coach?

A MOTOR truck body, a set of flanged wheels and a light automobile engine constitute the rolling stock of a Louisiana railway. The road connects Christie and Pearson and carries on a lively business. The "super-jitney," as it has been designated, operates on a regular time schedule and is able to make excellent speed despite its rather cumbersome appearance. It can conveniently accommodate twenty passengers, and in addition can haul a great deal of express and merchandise, by stowing it under the seats or on the top of the coach. No matter how heavy the load, there is practically no vibration, for the railroad bed is still in good condition.

ANOTHER AMERICAN CLASSIC

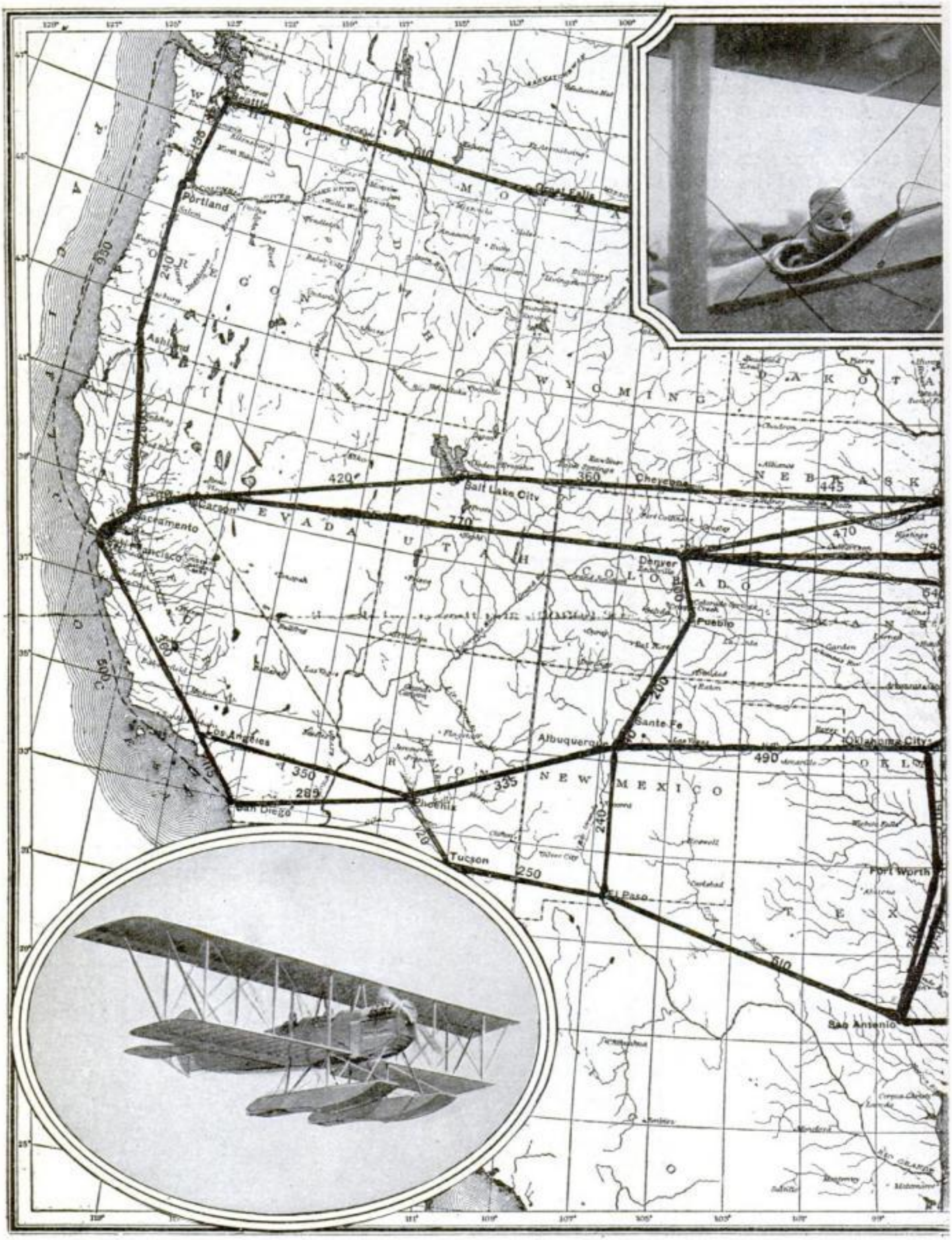
"AUGUST 27, 1917.

"TO HIS HOLINESS, BENEDICTUS XV, POPE:

"IN ACKNOWLEDGMENT OF THE COMMUNICATION OF YOUR HIGHNESS TO THE BELLIGERENT PEOPLES, DATED AUGUST 1, 1917, THE PRESIDENT OF THE UNITED STATES REQUESTS ME TO TRANSMIT THE FOLLOWING REPLY: "EVERY HEART THAT HAS NOT BEEN BLINDED AND HARDENED BY THIS TERRIBLE WAR MUST BE TOUCHED BY THIS MOVING APPEAL OF HIS HOLINESS, THE POPE. MUST FEEL THE DIGNITY AND FORCES OF THE HUMANE AND GENEROUS MOTIVES WHICH PROMPTED IT, AND MUST FERVENTLY WISH THAT WE MIGHT TAKE THE PATH OF PEACE HE SO PERSUASIVELY POINTS OUT. BUT IT WOULD BE FOLLY TO TAKE IT IF IT DOES NOT IN FACT LEAD TO THE GOAL HE PROPOSES. OUR RESPONSE MUST BE BASED UPON STERN FACTS AND UPON NOTHING ELSE. IT IS NOT A MERE CESSATION OF ARMS HE DESIRES; IT IS A STABLE AND ENDURING PEACE. THIS AGONY MUST NOT BE GONE THROUGH WITH AGAIN, AND IT MUST BE A MATTER OF VERY SOBER JUDGMENT WHAT WILL INSURE US AGAINST IT. "HIS HOLINESS, IN SUBSTANCE PROPOSES THAT WE RETURN TO THE STATUS QUO ANTE BELLUM AND THAT THEN THERE BE A GENERAL CONDONATION, DISARMAMENT AND A CONCERT OF NATIONS BASED UPON ACCEPTANCE OF THE PRINCIPLE OF ARBITRATION. THAT BY A SIMILAR CONCERT FREEDOM OF THE SEAS BE ESTABLISHED; AND THAT THE TERRITORIAL CLAIMS OF FRANCE AND ITALY, THE PERPLEXING PROBLEMS OF THE BALKAN STATES, AND THE RESTITUTION OF POLAND BE LEFT TO SUCH CONCILIATORY ADJUSTMENT AS MAY BE POSSIBLE IN THE NEW TEMPER OF SUCH A PEACE. DUE REGARD BEING PAID TO THE ASPIRATIONS OF THE PEOPLES WHOSE POLITICAL FORTUNES AND AFFILIATIONS WILL BE INVOLVED. "IT IS MANIFEST THAT NO PART OF THIS PROGRAM CAN BE SUCCESSFULLY CARRIED OUT UNLESS THE RESTITUTION OF THE STATUS QUO ANTE FURNISHES A FIRM AND SATISFACTORY BASIS FOR IT. THE OBJECT OF THIS WAR IS TO DELIVER THE FREE PEOPLES OF THE WORLD FROM THE MENACE OF AND THE ACTUAL POWER OF A VAST MILITARY ESTABLISHMENT CONTROLLED BY AN IRRESPONSIBLE GOVERNMENT WHICH, HAVING SECRETLY PLANNED TO DOMINATE THE WORLD, PROCEEDED TO CARRY OUT THE PLAN WITHOUT REGARD EITHER TO THE SACRED OBLIGATIONS OF TREATY OR THE LONG ESTABLISHED PRACTICES AND LONG CHERISHED PRINCIPLES OF INTERNATIONAL ACTION AND HONOR; WHICH CHOSE ITS OWN TIME FOR THE WAR; DELIVERED ITS BLOW FIERCELY AND SUDDENLY; STOPPED AT NO BARRIER, EITHER OF LAW OR OF MERCY; SWEPT A WHOLE CONTINENT WITHIN THE TIDE OF BLOOD—NOT THE BLOOD OF SOLDIERS ONLY, BUT THE BLOOD OF INNOCENT WOMEN AND CHILDREN, ALSO, AND OF THE HELPLESS POOR; AND NOW STANDS BALKED BUT NOT DEFEATED, THE ENEMY OF FOUR-FIFTHS OF THE WORLD. THE POWER IS NOT THE GERMAN PEOPLE. IT IS NO BUSINESS OF OURS HOW THAT GREAT PEOPLE CAME UNDER ITS CONTROL OR SUBMITTED WITH TEMPORARY ZEST TO THE DOMINATION OF ITS PURPOSES; BUT IT IS OUR BUSINESS TO SEE TO IT THAT THE HISTORY OF THE REST OF THE WORLD IS NO LONGER LEFT TO ITS HANDLING. "TO DEAL WITH SUCH A POWER BY WAY OF PEACE UPON THE PLAN PROPOSED BY HIS HOLINESS, THE POPE, WOULD SO FAR AS WE CAN SEE, INVOLVE A RECUPERATION OF ITS STRENGTH AND A RENEWAL OF ITS POLICY; WOULD MAKE IT NECESSARY TO CREATE A PERMANENT HOSTILE COMBINATION OF NATIONS AGAINST THE GERMAN PEOPLE, WHO ARE ITS INSTRUMENTS; AND WOULD RESULT IN ABANDONING THE NEW BORN RUSSIA TO THE INTRIGUE, THE MANIFOLD SUBTLE INTERFERENCE AND THE CERTAIN COUNTER REVOLUTION WHICH WOULD BE ATTEMPTED BY ALL THE MALIGN INFLUENCES TO WHICH THE GERMAN GOVERNMENT HAS OF LATE ACCUSTOMED THE WORLD. CAN PEACE BE BASED UPON A RESTITUTION OF ITS POWERS OR UPON ANY WORD OF HONOR IT COULD PLEDGE IN A TREATY OF SETTLEMENT AND ACCOMMODATION? RESPONSIBLE STATESMEN MUST NOW EVERYWHERE SEE, IF THEY NEVER SAW BEFORE, THAT NO PEACE CAN REST SECURELY UPON POLITICAL OR ECONOMIC RESTITUTIONS MEANS TO BENEFIT SOME NATIONS AND CRIPPLE OR EMBARRASS OTHERS; UPON VINDICTIVE ACTION OF ANY SORT OR ANY KIND OF REVENGE OR DELIBERATE INJURY. THE AMERICAN PEOPLE HAVE SUFFERED INTOLERABLE WRONGS AT THE HANDS OF THE IMPERIAL GERMAN GOVERNMENT, BUT THEY DESIRE NO REPRISAL UPON THE GERMAN PEOPLE, WHO HAVE THEMSELVES SUFFERED ALL THINGS IN THIS WAR, WHICH THEY DID NOT CHOOSE. THEY BELIEVE THAT PEACE SHOULD REST UPON RIGHTS OF PEOPLES, NOT THE RIGHTS OF GOVERNMENTS—THE RIGHT OF PEOPLES, GREAT OR SMALL, WEAK OR POWERFUL—THEIR EQUAL RIGHT TO FREEDOM AND SECURITY AND SELF-GOVERNMENT AND TO A PARTICIPATION UPON FAIR TERMS IN THE ECONOMIC OPPORTUNITIES OF THE WORLD—THE GERMAN PEOPLE, OF COURSE, INCLUDED, IF THEY WILL ACCEPT EQUALITY AND NOT SEEK DOMINATION. "THE TEST, THEREFORE, OF EVERY PLAN OF PEACE IS THIS: IS IT BASED UPON FAITH OF ALL THE PEOPLES INVOLVED OR MERELY UPON WORD OF AN AMBITIOUS AND INTRIGUING GOVERNMENT ON THE ONE HAND, AND A GROUP OF FREE PEOPLES, ON THE OTHER, THIS IS A TEST THAT GOES TO THE ROOT OF THE MATTER; AND IT IS THE TEST WHICH MUST BE APPLIED. "THE PURPOSES OF THE UNITED STATES IN THIS WAR ARE KNOWN TO THE WHOLE WORLD—TO EVERY PEOPLE TO WHOM THE TRUTH HAS BEEN PERMITTED TO COME. THEY DO NOT NEED TO BE STATED AGAIN. WE SEEK NO MATERIAL ADVANTAGE OF ANY KIND. WE BELIEVE THAT THE INTOLERABLE WRONGS DONE IN THIS WAR BY THE FURIOUS AND BRUTAL POWER OF THE IMPERIAL GERMAN GOVERNMENT OUGHT TO BE REPAIRED, BUT NOT AT THE EXPENSE OF THE SOVEREIGNTY OF ANY PEOPLE—RATHER A VINDICATION OF THE SOVEREIGNTY, BOTH OF THOSE THAT ARE WEAK AND THOSE THAT ARE STRONG. PUNITIVE DAMAGES, THE DISMEMBERMENT OF EMPIRES, THE ESTABLISHMENT OF SELFISH AND EXCLUSIVE LEAGUES, WE DEEM INEXPEDIENT AND IN THE END WORSE THAN FUTILE. NO PROPER BASIS FOR A PEACE OF ANY KIND, LEAST OF ALL FOR AN ENDURING PEACE, THAT MUST BE BASED UPON JUSTICE AND FAIRNESS AND THE COMMON RIGHTS OF MANKIND. "WE CANNOT TAKE THE WORD OF THE PRESENT RULERS OF GERMANY AS A GUARANTEE OF ANYTHING THAT IS TO ENDURE, UNLESS EXPLICITLY SUPPORTED BY EVIDENCE OF THE WILL AND PURPOSE OF THE GERMAN PEOPLES THEMSELVES AS THE OTHER PEOPLES OF THE WORLD WOULD BE JUSTIFIED IN ACCEPTING. WITHOUT SUCH GUARANTEE, TREATIES OF SETTLEMENT, AGREEMENTS FOR DISARMAMENT, COVENANTS TO SET UP ARBITRATION IN THE PLACE OF FORCE, TERRITORIAL ADJUSTMENTS, RECONSTITUTIONS OF SMALL NATIONS, IF MADE WITH THE GERMAN GOVERNMENTS NO MAN, NO NATION COULD NOW DEPEND ON. WE MUST WAIT SOME NEW EVIDENCE OF THE PURPOSES OF THE GREAT PEOPLES OF THE CENTRAL POWERS. GOD GRANT IT MAY BE GIVEN SOON AND IN A WAY TO RESTORE THE CONFIDENCE OF ALL PEOPLES, EVERYWHERE, IN THE FAITH OF NATIONS AND THE POSSIBILITY OF A CO-ELANTED PEACE."

Hold the illustration at arm's length and the effect will become much more apparent

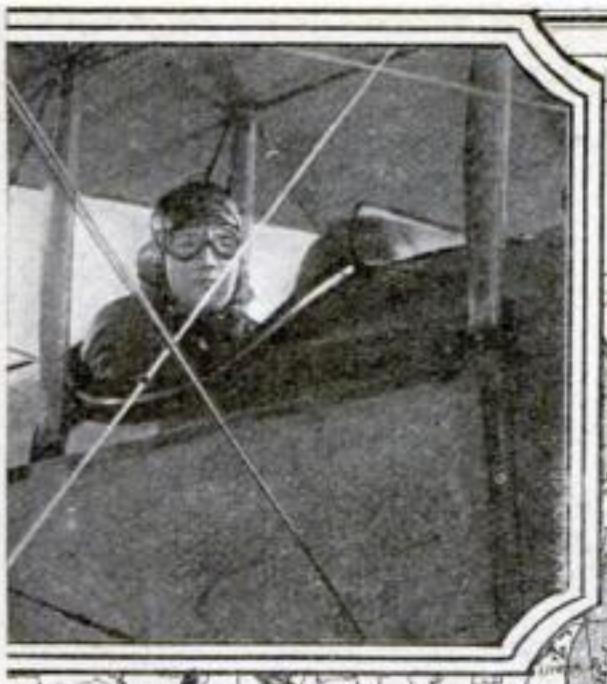
Because Transportation Is Civilization the World Is



Redrawn from a chart prepared by the Curtiss Aeroplane Corporation

Kipling's dream that the year 2000 would see the earth and the air above it planned and plotted for aeronautical traffic has already been realized. Here we are thinking of the air as the world's medium of transportation for mail service, passenger and freight traffic! Men are mapping our aerial highways in France, Germany, England, Italy and the United States, preparing for the day when air travel will take precedence of nearly all other human activities. Running al-

Preparing Itself for Commercial Domination of the Air



most directly between New York and San Francisco is the Woodrow Wilson Air Highway. Branch air highways connect all principal cities of the country. Will this map be a network of lines in a few years, with commercial airplanes flying at two thousand feet, great express machines flying at four thousand feet and military and police planes flying at about six thousand feet?

Photos © by Press Illus. Serv.

A Track-Laying Tractor

Its front wheel lays a track and the whole machine turns in a ten-foot circle

Above: Plowing a field with the aid of the track-laying tractor

At right: The tractor can easily make a turn in a ten-foot circle

Above: The shoes are made of steel stampings. They can be provided with projections for very soft ground

OUT in California, where the small, farm tractor has been more highly developed than in any other part of the world, an unusual tractor has appeared. It has three wheels like many other tractors. But in this case, to give great pulling power, the front or steering wheel is a track-laying wheel. Still, the unusual characteristic of the tractor is not so much the small track-laying unit used as a front wheel, but the manner in which the frame supporting the unit is employed to carry the small automobile internal-combustion engine and its fuel and water tanks. An inverted, U-shaped casting, attached to the rear of the frame, permits the whole frame, track-layer and engine, to turn as a unit when the tractor rounds a corner.

The top of the U-shaped casting serves as a turning pivot for a goose-neck frame, to which is attached the two rear steel wheels, and the axle to which the plows or harrows employed are attached.

The tractor is further characterized by burning the cheap engine distillate so commonly used in California in place of expensive gasoline.

In the accompanying illustrations, it can be clearly seen that the engine is mounted as in any automobile, longitudinally of the frame, but that it drives the track-laying wheels by means of a two-part, cone-shaped friction gear mounted on the rear end of the extended engine-shaft. The shoes or face of the endless track, somewhat similar to those used on the famous British "tanks," although much smaller, are made of steel stampings. They can be left flat for running over firm roads or they can be provided with angle-iron grousers or projections to grip very soft ground.

The tractor may be used for any kind of farm cultivation. It has a speed of about two miles an hour when pulling a four gang plow. The machine weighs less than three thousand pounds, has an overall length of one hundred and two inches and can turn completely around in a ten-foot circle. Its small size is one of its greatest assets.

Why the Horse Is An Aristocrat

He is the product of an ancestry
that goes back three million years

THE earliest known ancestor of the horse, called the Eohippus or "Dawn Horse," is believed to have existed more than three million years ago, in what is known as the Eocene Age, hundreds of thousands of years before the coming of man. Fossil remains of that animal were found in certain rock strata in this country. From the remains of a skeleton uncovered in New Mexico; J. W. Gidley, one of the scientists connected with the United States National Museum, in Washington, D. C., reconstructed the interesting model which is pictured here.

© Pruss Illus. Serv.

Above appears the highest type of horse, the result of many centuries of careful breeding and selection. At his feet is shown his earliest ancestor, the Eohippus, who stood little more than fourteen inches high at the shoulder

This earliest known ancestor of the horse was about the size of a small fox, standing a little more than fourteen inches high at the shoulder. He had four toes on each of his front feet and three-toed hind feet. His teeth were small and short-crowned. He probably lived around the margins of lakes, where the ground was more or less soggy, and pastured on grass.

In the course of thousands of centuries, his physique developed as his needs required. His size increased and his skeleton underwent important changes in accordance with his altered living conditions and habits.

The horse of the Oligocene period, known as Mesohippus, was about the size of a sheep and had three toes on each foot. In the Miocene, a little later period, there were numerous large horses, all with three toes on each foot, but with the middle toe much larger than its companions. Their teeth were much longer, more powerful and much deeper-crowned.

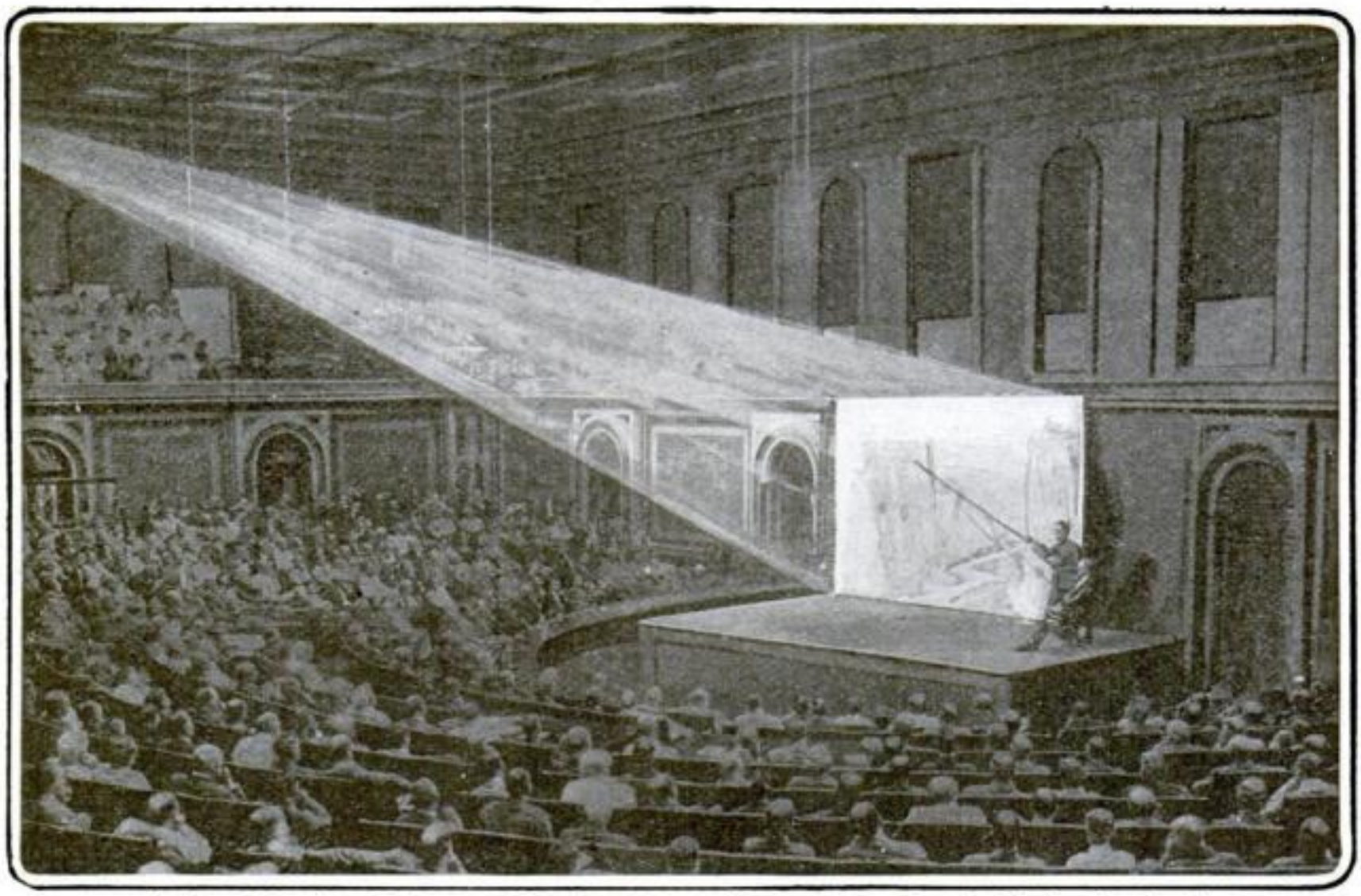
In a still later period, called the Pliocene, were found the first horses with but a single toe on each foot, which soon developed into a hoof. The auxiliary toes, being useless, disappeared, and only the stumps remained, traces of which may be seen in modern horses, even those of the highest stock.

True horses, of the form and approximate size of the modern steed, were not found until the Pleistocene period. These were common all over North America and Europe. Although they resembled the modern horse, they were smaller in size, and inferior in strength and fleetness.

Those of us interested in science, engineering, invention, form a kind of guild. We should help one another. The editor of The POPULAR SCIENCE MONTHLY is willing to answer questions.

Drawing Twenty Shades at Once

The stereopticon operator pushes a button and presto! the shades are raised or lowered

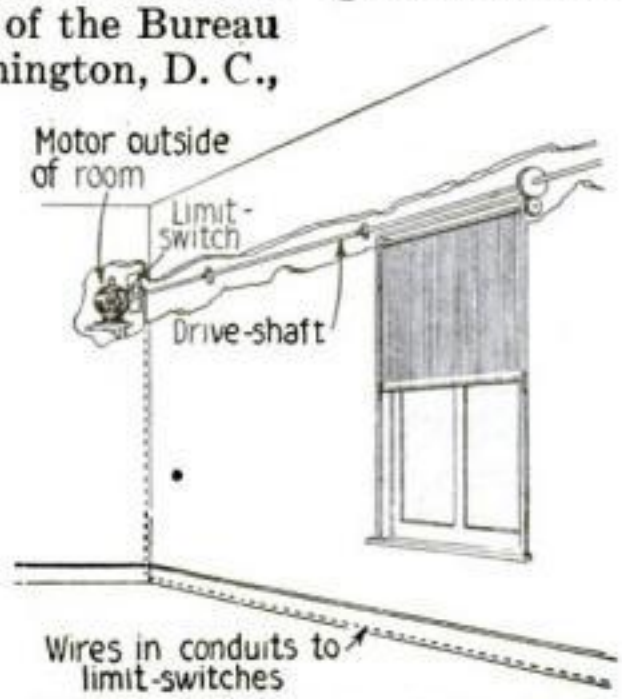


A simple push of a button by the stereopticon operator and all the shades in the auditorium are lowered simultaneously. Another push and they are raised

THE inconvenience of having to draw each window shade separately in an assembly room when motion pictures or stereopticon views are to be shown, has been overcome by an electrical device, which makes it possible to draw all the shades simultaneously by simply pushing a button. This new device is installed in the auditorium of the Bureau of Standards building, Washington, D. C., and is manipulated by the motion picture or stereopticon operator.

Two horizontal shafts extend on each side the full length of the room within the wall, directly over the window frames. Each shaft is revolved by means of a small electric motor, placed in a pocket in the wall just outside of the auditorium, as shown in the accompanying illustration. A special switch is installed near the motion-picture projector, by means of which the operator can easily turn the shaft in either direction, so as to raise or lower the shades.

Power is transferred from the motor shafts to the shades by means of gears on the shafts, which mesh with smaller gears mounted on one end of each roller. A limit switch controlled by the operator's main switch, breaks the circuit when the curtain has been pushed down to its lowest or up to its topmost position. The direction of revolution of the motor shaft is controlled by the operator's switch, and the gear on the motor shaft drives that on the end of the roller, as shown. The revolution of the motor shaft causes the threaded nut around the motor



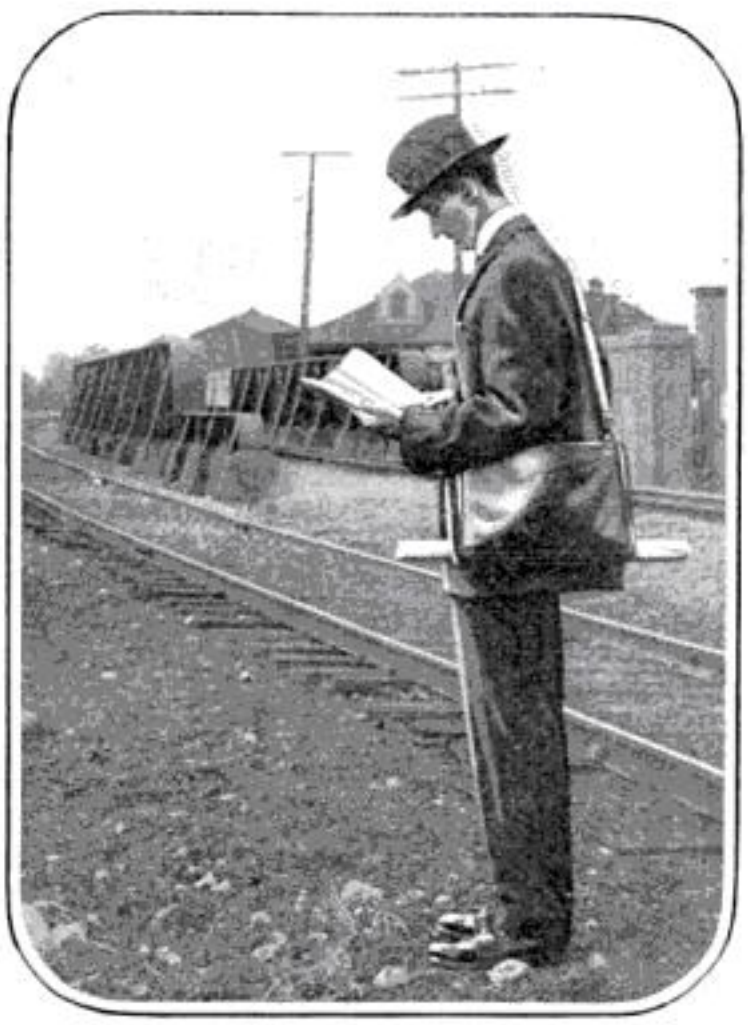
Details of the limit switch which opens and closes the circuits

shaft at the center of the switch to move in either direction and to break the current circuit by contacting with one or the other of the two bell-crank levers. The two movable rubber blocks on which the bell-crank levers are mounted, are adjusted by screws, working in the slots shown, so that the contact on the right opens when the curtains have reached their upper limiting positions, and that on the left when they have reached their lower limiting positions.

The system has a number of defects, due mainly to the fact that it was not installed until after the walls of the lecture room had been started. This made it necessary to operate the curtains entirely from the tops of the windows. It would be more satisfactory if the curtains could be operated from below rather than from above. This would allow them to be pulled down by the motor and then roll themselves up through the action of the roller spring, the pawl being removed to allow free action.

A Lawyer's Brief Case Is the Engineer's Knapsack

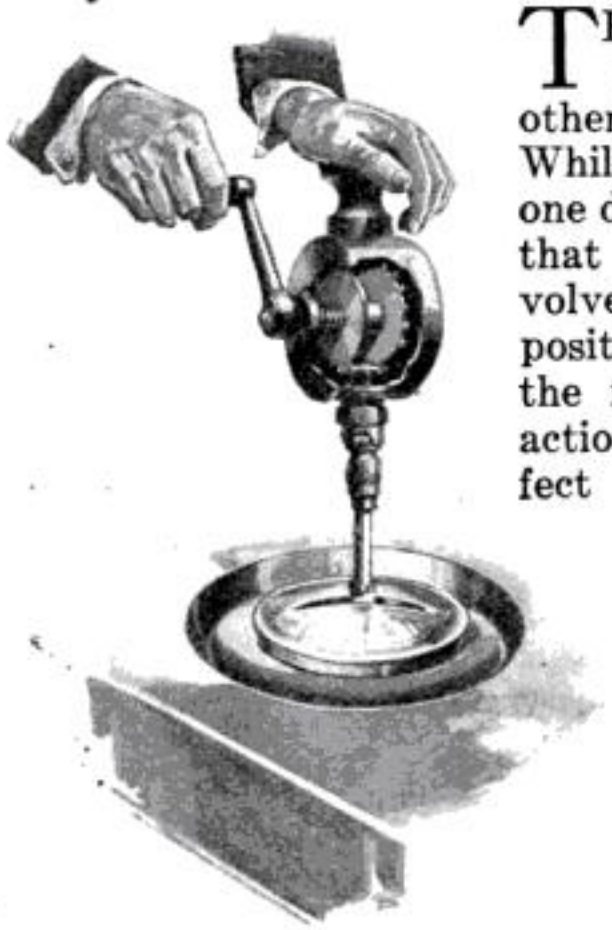
IF soldiers use knapsacks, why not engineers? So thought a railroad engineer and he straightway devised the knapsack shown. A strap is attached to an ordinary brief case and goes over the wearer's shoulders. As many as a dozen blueprints can be folded and tucked into the pockets of the case. Two straps are sewed on the back to serve as holders for rolled-up drawings that are too big to go into the case sections. For carrying his drawing instruments another pocket is placed just above the two straps. In this way, the engineer can carry supplies along and yet have his hands free.



A brief case converted into a knapsack for holding an engineer's blueprints

Here Is a New Tool for Grinding Your Automobile Engine Valves

THIS new type of valve grinder differs from others which you have seen. While the handle is turned in one direction only, the shank that turns the valve is revolved alternately in opposite directions to produce the forward and backward action so necessary for perfect valve grinding. This unusual action is secured through the use of two gears with segmental teeth, which alternately come into contact with a third horizontal gear on the top of the vertical shank of the device, as shown in the illustration.



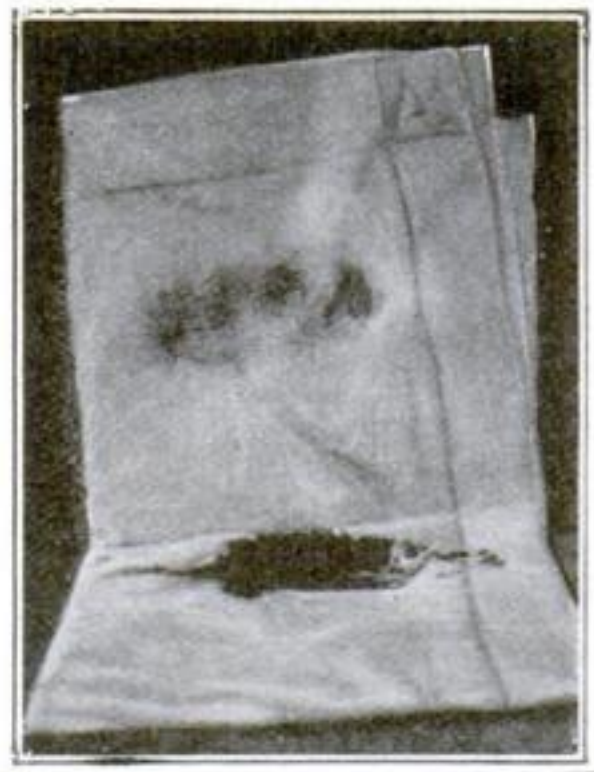
Though the handle is revolved in one direction only, the grinder part reverses itself

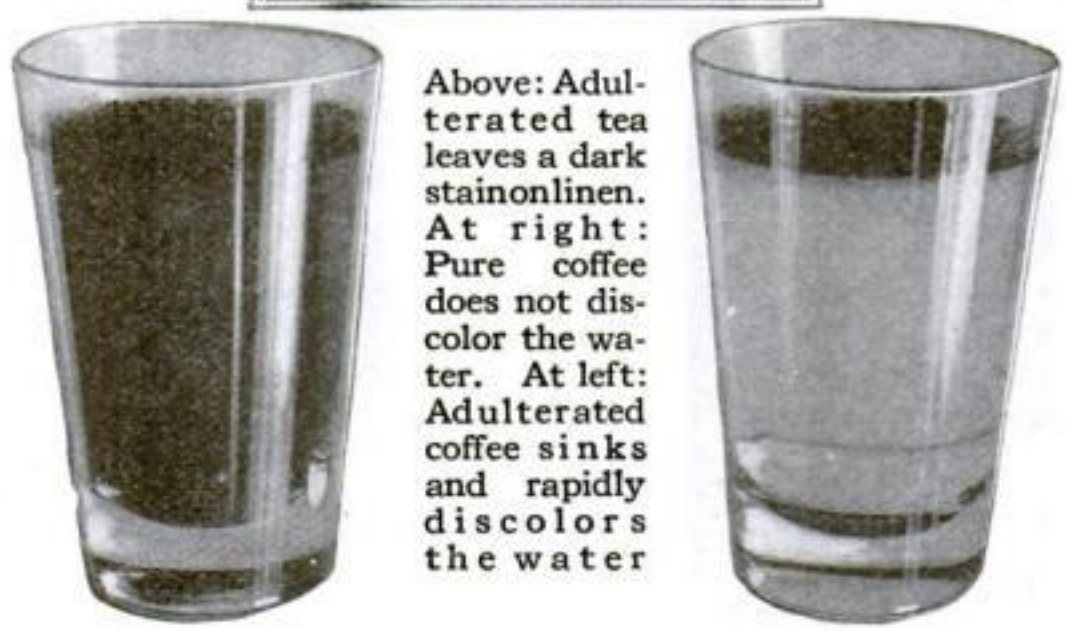
Wood Flour Is a New Product Made from Sawdust

WOOD flour is made by grinding dry sawdust in the same way that grain was formerly ground in the old-fashioned mills. At the present time it is used in ammunition plants as an absorbent in preparing dynamite. Chemically-bleached wood flour is used in making wood stucco and molding. In fact, wood flour is coming into wider commercial use each day.

Simple Home Tests for Tea and Coffee

THE commonest adulteration in the case of tea is the addition of what is known as "dressing." This is really a matter of dyeing. Poor tea is treated with certain substances in order to give it a fine, black color. The presence of "dressing" in tea may be detected by rubbing a sample of tea in a piece of fine white linen. A pocket handkerchief serves the purpose very well. If the tea is pure, only a little dust will be left on the handkerchief, and this dust may be blown away by your breath. If the tea has been treated, a dark stain will be found on the material.





Above: Adulterated tea leaves a dark stain on linen. At right: Pure coffee does not discolor the water. At left: Adulterated coffee sinks and rapidly discolors the water

The test for coffee is equally simple. Fill a tumbler with water and sprinkle a few grains of coffee on the surface of the water. Pure coffee will float, because the coffee bean contains so much oil that each grain is coated with a film of oil. If the coffee has been adulterated, the grains will sink and the water will become discolored. If chickory has been added to the coffee, the chickory grains will sink very rapidly while the coffee grains will continue to float.

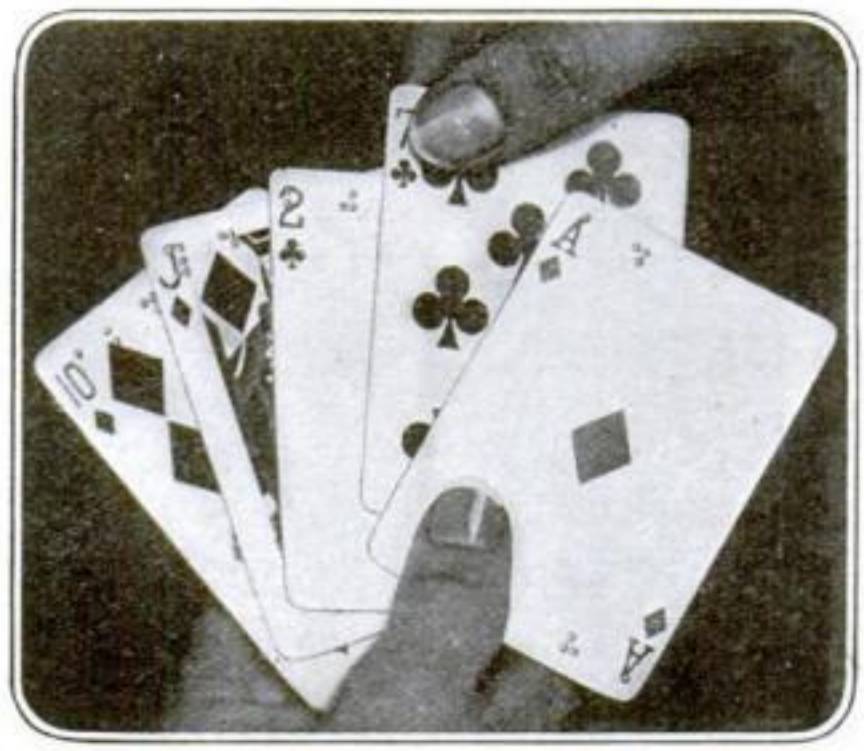
Thus easily you can determine the purity of tea or coffee.

There Is An Increasing Wastage of Adult Life

A CHILD born to-day has about ten times as many chances of living and growing to maturity as had the child born thirty years ago. On the other hand, a man forty years old has fewer years to live than had the man of the same age thirty years ago. Medical statistics prove that infant mortality and preventable diseases are decreasing, whereas degenerative diseases and cancer are increasing. However, the gravity of the wastage of adult life will not be appreciated until there is a nation-wide registration of the sick.

The Blind Have a Deck of Cards All Their Own

CARDS that have recently been devised for the blind have raised letters in the top and bottom corners that reveal their identity. By placing his thumb over the letters, the blind man can tell what cards he holds nearly as quickly as the ordinary person. Dots form the letters. "Two D" means that the card is the Two of Diamonds; "J.H." means the Jack of Hearts, and so on. At first the blind experience a little difficulty in reading the cards readily, but they soon become proficient.



With the aid of the raised letters on the cards, the blind can read them easily

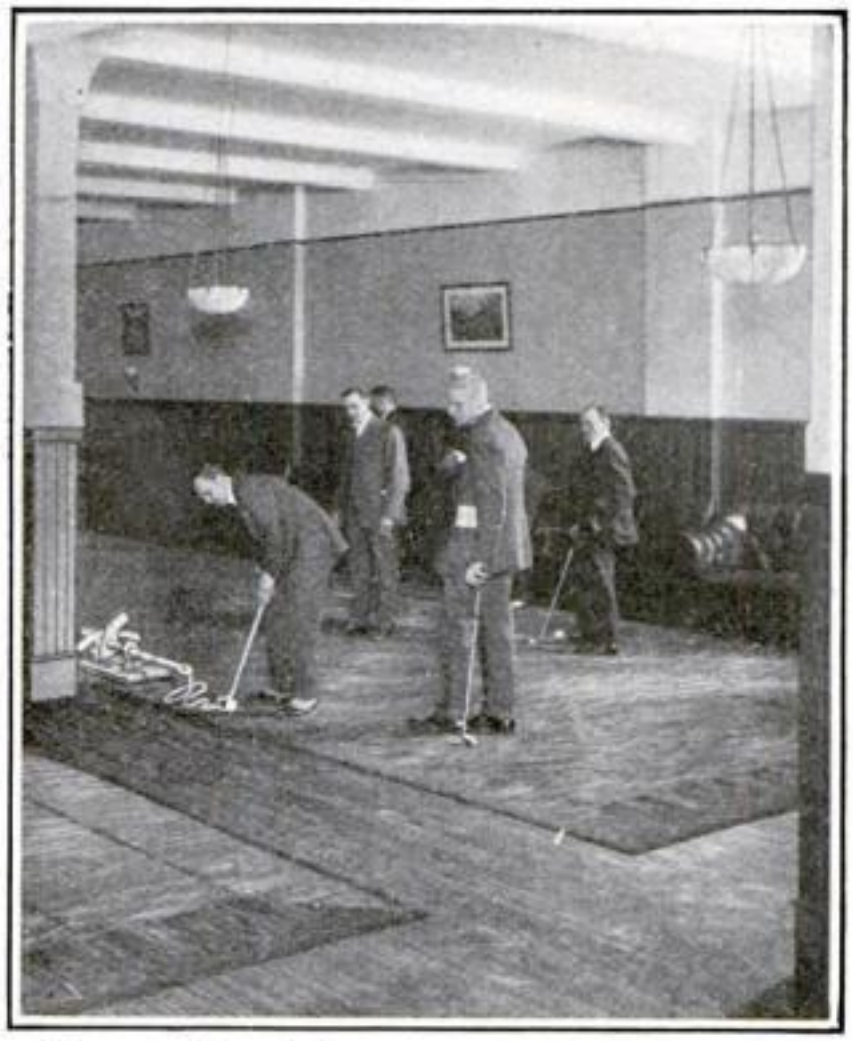
Two Hundred-Yard Drives in Your Parlor

"Fore" you yell, as of old, and hit the golf ball as hard as you like

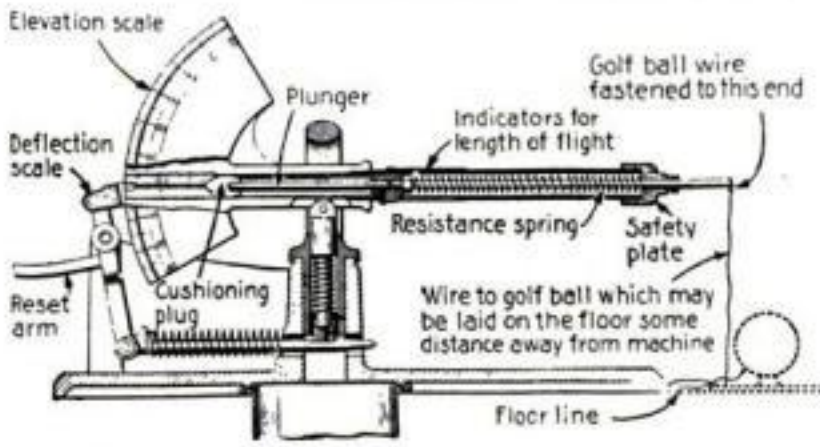
PARLOR golf would, in theory, seem to have all the benefits and thrills of parlor baseball, as both games are supposed to require much room, but you can make no inventor believe this.

The very latest endeavor to harness down the game to the confines of the largest apartment in your residence, is a machine which lets you whack the ball with all your might and which indicates not only the length of the drive, but also the elevation and deflection, so that you can judge what the ball might have done in the open air, untethered to an unromantic contraption of springs and things.

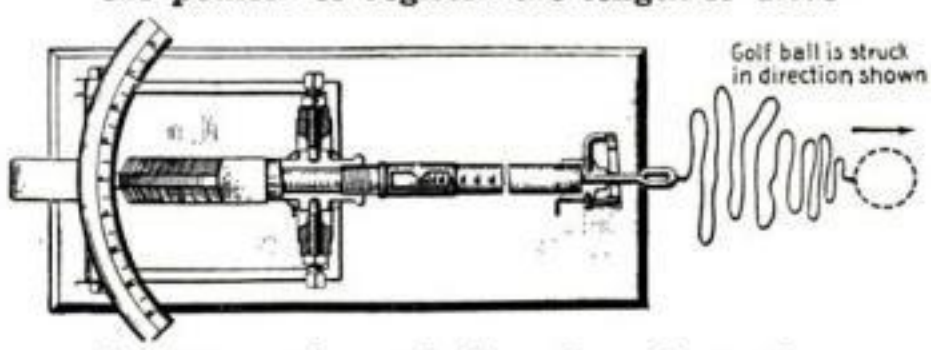
The machine consists first of a plunger working in a stout tube and compressing a coiled spring as it is drawn out. On the tube are graduations representing yards of drive. The ball is harnessed to the end of this plunger by a stout bit of wire rope, then it is teed or whatever is the preliminary necessary to smacking it clear out of the county, and the golfer soaks it with all the malice he would display in an attempt to reach a green two hundred difficult yards away.



The machine indicates not only the length of the drive but also the elevation and deflection



When the ball is struck, the plunger is forced out and compresses a coiled spring, causing the pointer to register the length of drive



Lateral and vertical scales show the elevation and deflection of the ball, which is fastened to the plunger with wire rope

The blow yanks out the plunger against the force of the coiled spring. By the construction of the tube, the plunger is held out at the point where it stops, lest the returning spring smite the golfer with the ball. A pointer indicates on the tube the number of yards the ball would have gone in a real game.

Also, as the barrel containing the plunger is free to swing upward or sideways, there are provided lateral and vertical scales to show whether the ball would have gone straight, and whether in elevation it would have endeavored to emulate the cow that jumped over the moon. Fortunately, no provision is made for measuring the strength and fluency of the language used in case the ball is missed or topped as it is semi-occasionally indoors as well as outdoors.

A Sandpaper Label for the Poison Bottle Gives Warning in the Dark

PERHAPS the simplest of all devices for protecting people from taking doses from poison bottles by mistake, is the sandpaper label shown in the accompanying illustration. The actual label with its usual skull and crossbones is pasted on a piece of sandpaper large enough to go all around the bottle, so that when you take up the bottle in the night, no matter how dazed from sleep you may be, the rough unfamiliar feel of the sandpaper rouses you, and you recognize at once that the bottle contains poison of some description. The printed label will tell the kind.

The sandpaper label is pasted on a bottle which contains poison

A Trolley Hoist for Handling Coal

IN small boiler plants where coal has to be transferred from an outside bin to the furnace doors, the small electric, cord-operated trolley hoist shown in the accompanying illustration solves the problem economically in almost every case. The hoist shown is filled by hand but is self-dumping and self-righting. It has a carrying capacity of a half ton of coal.

The overhead trolley on which the hoist is suspended is carried clear into the boiler-room which is in the building shown in the background, so that one man, with simply the labor of filling the bucket, can keep a battery of boilers supplied with coal all day long. The bucket can be raised or lowered at will while it is traveling to and fro between the coal pile and the boilers by simply pulling on the operating cord.

To Make Your Shoes Last Longer, Oil Them Occasionally

WHEN your shoe leather gets dry or hard, you should oil or grease it. To do this, first brush off all mud and then wash the shoe in warm water, drying it with a soft cloth.

While the shoe is still wet, apply the oil or grease, rubbing it in with a swab of wool, or better still, with the palm of the hand. After treatment, the shoes should be left to dry in a warm, but not in a hot place. Castor oil is recommended for shoes that are to be polished. For plainer footgear, fish oil and oleine or any one of the less expensive oils may be substituted with very good results.

Although self-dumping and self-righting, the hoist is filled by hand. It can lift half a ton of coal

"Ninety Degrees" says the Regulator

And that will be the unchanging temperature of your bath

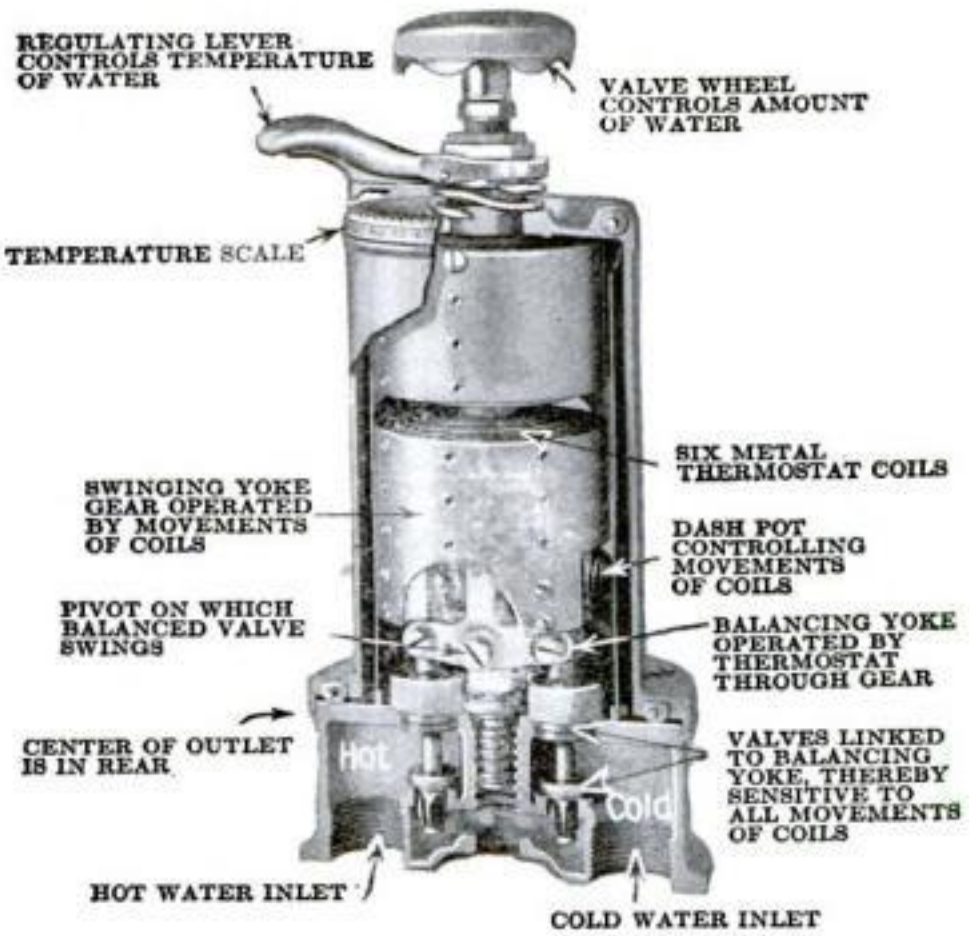
At the top of the contrivance here illustrated, a little lever slides over a small, circular and graduated scale. Set this lever at any point you like—the scale reads in degrees Fahrenheit—open a valve and forthwith your bath water comes out at the right temperature. Once having set this lever, you may let the water run an hour or more; in fact, any length of time, and still the temperature remains unchanged—this in spite of the fluctuation in the supplies of hot and cold water fed to the contrivance. And hot and cold supplies do fluctuate, as anyone who has ever stood under a shower bath knows. Alternate freezings and scaldings are not pleasant.

Even the baby enjoys a bath in which the temperature of the water does not change. Look at the happy expression on his face

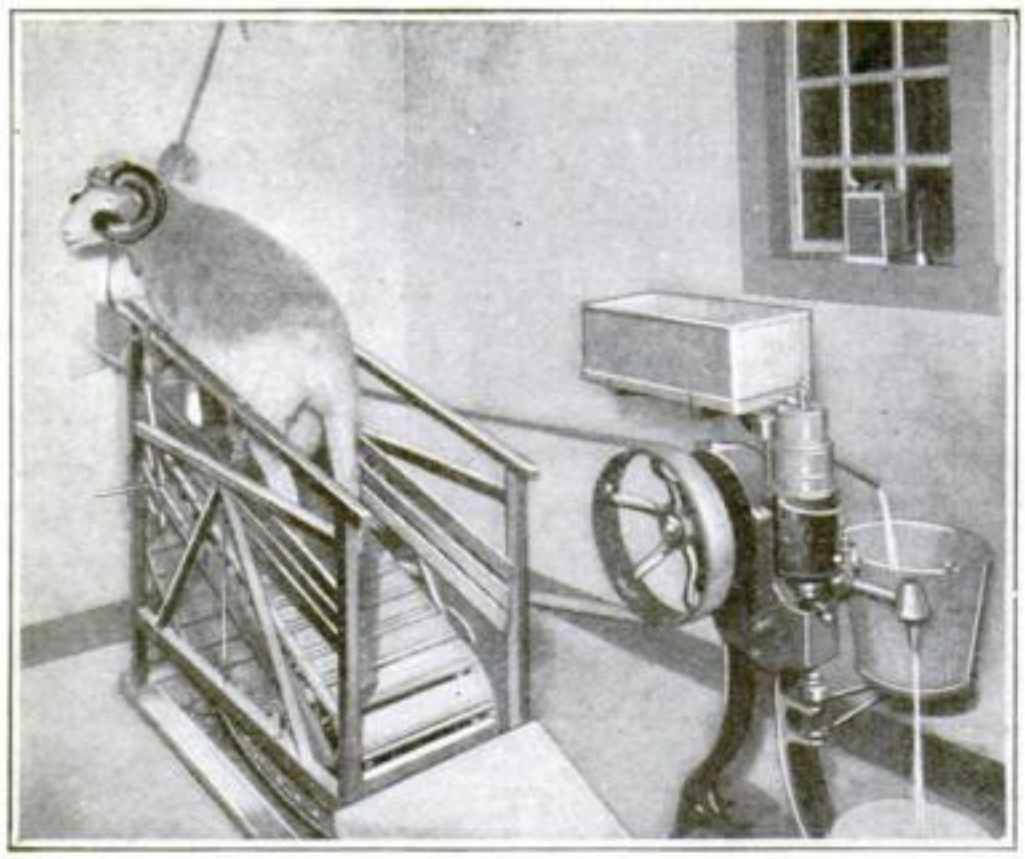
The illustration shows the principal working parts and their functions. The big cylindrical coils of the machine are made of two unlike metals welded or riveted together to form a thermostat. The metals expand or contract with changes in temperature very much as does the hairspring on a watch at each tick. The regulating lever at the top controls the amount of this expansion or contraction just as does the "fast" and "slow" lever on a time-piece. Thus the temperature of the water is controlled. The motion of the spirals with changes in temperature are passed along to the balanced valve at the bottom of the machine by means of a yoke hidden in the interior. As a result of the thermostat's action, the balanced valve can open the hot and cold water supplies only to the right degree and proportion necessary to produce the temperature desired.

The machine is of great use in hospitals where many baths of widely varying temperature must be given to patients. Laundries also find the contrivance of value in controlling the hotness of water used on fine fabrics.

Several sizes are manufactured, from a small one suited to the home, to others of large capacity adapted to the needs of sanitariums, hotels, Y. M. C. A.'s, and similar users. Having only a lever to set, and a valve to open, the machine is easily operated.



The principal parts of the water regulator and their functions. There are six metal thermostat coils



The ram walks on the treadmill and operates the separator without being conscious of the indignity

Making a Ram Drive a Cream Separator

A CREAM separator run by ram power is something of a novelty. The ram tries to walk out of the room, but as he is standing on a treadmill, all he does is to operate the machine for separating the cream from the milk. The proceeding is not only inhuman, but expensive in the long run.

A Six-in-One Article—A Revelation in Usefulness

A POCKET article about the size of a fountain pen, which, after investigation, proves to be fully equipped to perform all the arduous duties of a comb, a ruler, a pencil-holder, a nail-file and an envelope opener, has been invented by Mandius J. Munson, of Los Angeles, California. In its simple dress, the article looks like a combined ruler and pencil, but a mere touch transforms it into a comb or into an envelope opener. All of it is made of aluminum, except a small file of thin steel which serves as the nail-file.

The inventor claims it would remind children to keep their hair combed and their finger nails cared for. And all this for two cents!

It's a comb, a ruler, a pencil-holder, a nail-file and an envelope opener all in one

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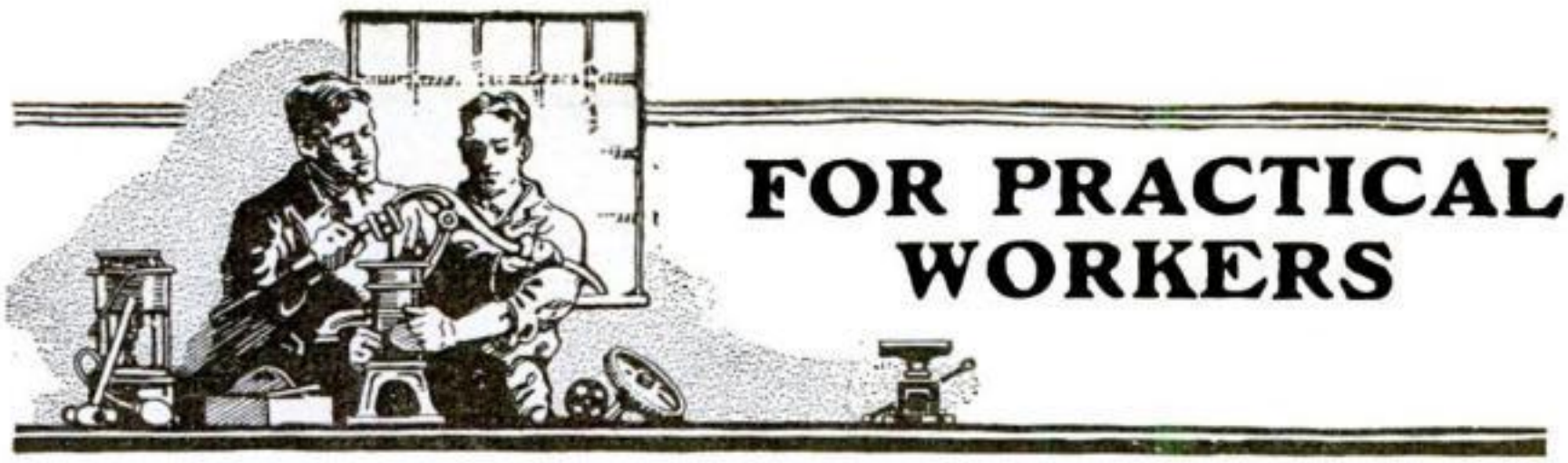
The Diseases for Which Man Blames the Beasts

ALTHOUGH animals are not affected by the sicknesses and communicable diseases of man, yet, for some unexplainable reason, the scientists and physicians declare that a whole host of oft-times fatal ailments of mankind are traceable to the beasts. The horse is blamed for spreading glanders, rabies, lockjaw and other diseases of five or more syllables. Dogs and cats are branded as the circulators of rabies, parasitic worms of different kinds, fleas and ticks. The cow is the worst offender. The list of diseases laid at her barn-door is headed with tuberculosis and grows constantly more blood curdling, until we wonder why physicians and scientists consent to the use of milk, butter and cheese which still lead the dietitians' list of nutritives.

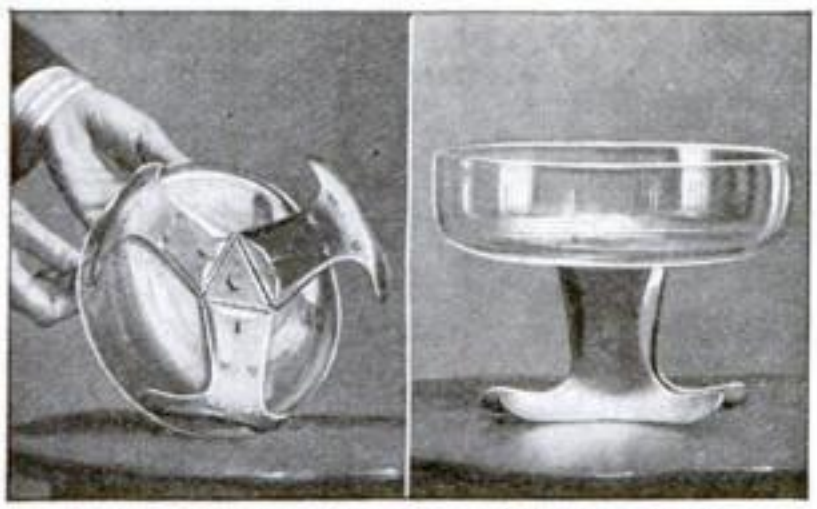
Rats, squirrels and fleas spread the bubonic plague. We are prepared to believe that lice and bedbugs, flies and mosquitoes are the rapid transit lines for yellow fever and malaria. We are willing to forego the luscious oyster all the year round, if need be, to avoid typhoid fever. It will go hard with many of us, though, if the fish-day diet must be cut out on account of the possibility of tapeworm which the scientists say fish food carries.



FOR PRACTICAL WORKERS

Fish Bowl with Folding Stand for the Magician

THIS very serviceable fish bowl is really of a collapsible variety. Contrary to appearance, it can be folded up-water, fish and all—and carried beneath



The curved metal legs fold up snugly against the sides of the glass bowl

your coat. To substantiate this statement it can be said that this bowl is the invention of one of the world's greatest "eye foolers"—an old-time magician named Hartz. From an empty cloth he magically produced six of these bowls. This, however, was an unusual achievement which perhaps only Hartz could do. But anyone can hide one of these bowls beneath his coat.

To begin with, the legs fold up flat against the sides of the bowl. A rubber cover, slipped over the mouth of the bowl, keeps the water in. The bowl is hidden under the coat and held in position by the pressure of one arm. As the conjurer waves his cloth, one hand steals beneath the coat and brings out the bowl. The metal legs snap into an upright position by means of a series of rubber bands fastened to each leg.

In taking off the cloth, the rubber cover is removed, thus displaying a bowl about 7 in. high and 8 in. wide, brimful of water and swimming gold-fish. The fish are generally known as "three-carat gold-fish" because they are composed of three red carrots whittled into shape.

Unequally Adjusted Rear Wheel Brakes Cause Skidding

BRAKES that are not properly adjusted will cause a skid on slippery pavements. A way to find this fault is to drive the car on a dry road, to accelerate quickly, then suddenly to apply the brakes. If one wheel skids and the other keeps turning, this shows that the brake on the sliding wheel is set tighter than its mate.

A Bench Holder for a Large Pair of Tinner's Snips

USUALLY, snips that are used for cutting sheet metal, if they are of medium or large size, are heavy and clumsy to handle, and it is difficult to cut on a straight line. To overcome this, I mounted a heavy pair on a hardwood base about 6 in. wide and as long as the snips. This dimension may be as desired,

A wood base and blocks to hold tinner's snips so that they are easy to handle

as shown in the illustration. In this way, bench shears are made and they are portable and easy to handle. With this arrangement, it is surprising how straight the snips will cut.—W. E. DAY.

A Homemade Focusing Hood for a Hand Camera

THE plate camera, although a little slower to arrange for procuring a picture, will usually give better results than other kinds, owing to the fact that it can be brought into perfect focus, by adjusting

A hood for the camera back for keeping light from ground glass while focusing

the image shown on the ground glass. The greatest difficulty in doing this has been in cutting off the side lights. This is usually done with a cloth thrown over the head, which method is uncomfortable and slow.

The hood, shown in the illustration, can be attached very easily and can be telescoped small enough to carry conveniently in the pocket or case. First, cut four pieces of paste-board about 2 in. in width and long enough to fit around the frame of the camera. Two of these pieces should be slightly shorter than the others. Sew the four pieces together to form the frame. In pulling the joints together, at least 1/16 in. should be left to allow the frame to fold when placed in the pocket. A piece of black oilcloth is then procured and cut according to the pattern shown. White oilcloth may also be used just as successfully.

After stitching the V-shaped edges together, the shape is pyramidal. Now place the larger opening over the paste-board frame, allowing it to lap about 1 in., and sewing it firmly to the frame. Fasten a wire around the opposite or smaller opening, and hem the oilcloth over the wire.

When this hood is placed over the camera, the door of camera can be opened back into it, allowing a perfect view for focusing.—CHAS. CLAUDE WAGNER.

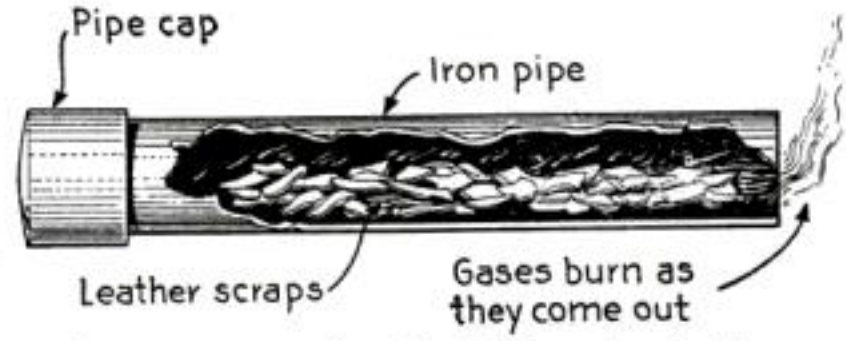
An Indestructible Paper Weight and Blotter

A BLOTTER and paper weight which is practically indestructible, can easily be made by mixing 7 parts (by weight) of gypsum, one part of potato flour and a small portion of water. Just enough water should be used to dampen the mixture. The ingredients should immediately be poured into a well greased mold, and there allowed to dry thoroughly. Then they will be quite ready for use.—W. S. STANDIFORD.

Making Bone Black from Scraps of Leather

THE apparatus illustrated is for the purpose of manufacturing bone black—animal charcoal or ivory black, as it is called. I have made this pigment for black shoe polish or paste, discoloring liquids, filtering, etc.

It consists of an ordinary piece of pipe—the size depending on the amount to be heated, or burned—capped on one end, with the other end left open to make it convenient for filling and to provide escape for the gases. The pipe is half filled with scraps from old shoes and harness. The filled pipe is then laid with the capped end in a furnace or in the fire-box of a stove, allowing the open end to extend out where the gases coming from



Arrangement of a pipe for burning leather scraps to make an ivory black pigment

the pipe will burn during the operation. The animal charcoal obtained from the leather scraps is free enough from any mineral substance to need no acid treatment whatever.—HENRY KLAUS.

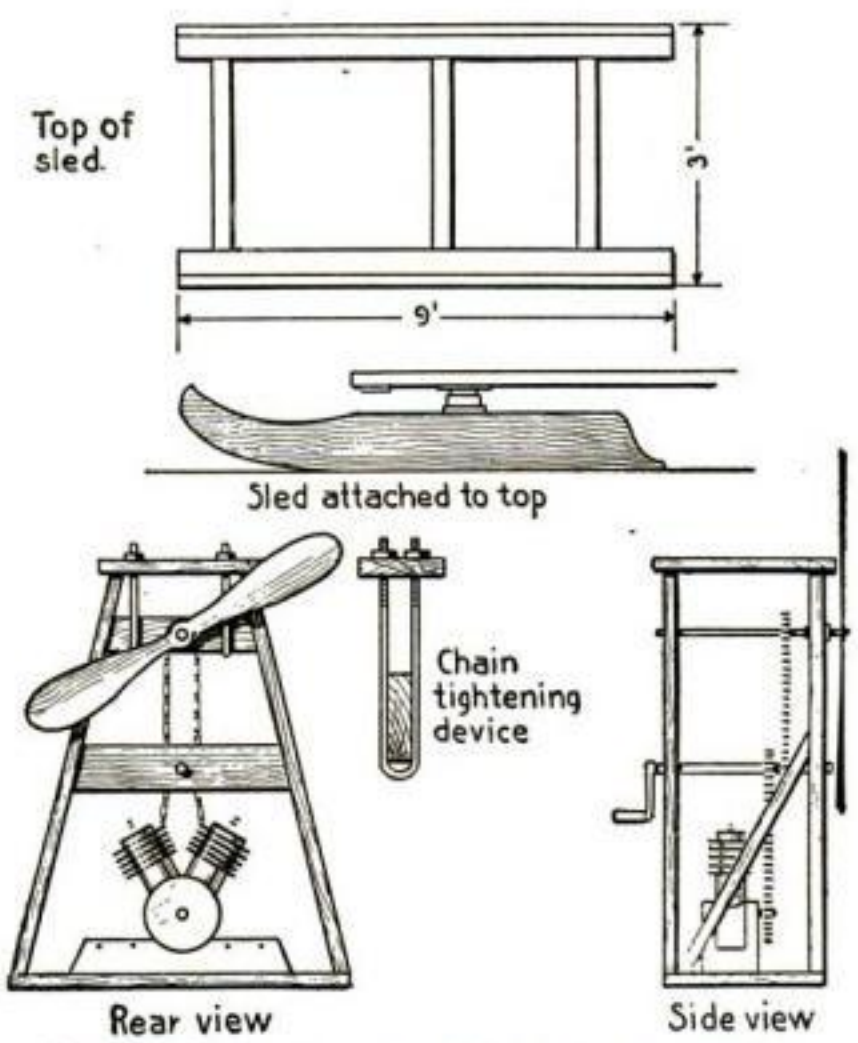
A Sled Driven by a Motorcycle Engine and Airplane Propeller

ANY one who possesses a motorcycle or has access to a motorcycle engine, can make use of it to good advantage for the winter months by using its power to drive a sled. While the power may be applied to the driving wheel that has spikes for pushing the sled, it may also be used to drive a propeller, similar to that of an airplane, which thrusts the sled forward with air pressure. The illustration shows such a power sled.

While the plans give only general dimensions, they are suggestive of an arrangement to hold the engine and its connections to the propeller shaft. The size of the engine and the sled will determine the size and height of the standards.

In constructing the sled shown, the power plant was fastened to the rear end of the frame, which is about 9 ft. long and 3 ft. wide, constructed of boards about 6 in. wide and 1½ in. thick at the edges; and cross braced with boards 1 in. thick. The runners of the sleds are 4 ft. long.—GEO. M. FOX.

Details of the sled runner, top and frame that supports the shaft and propeller



An airplane propeller driven by a gasoline engine is the new motive power for this sled

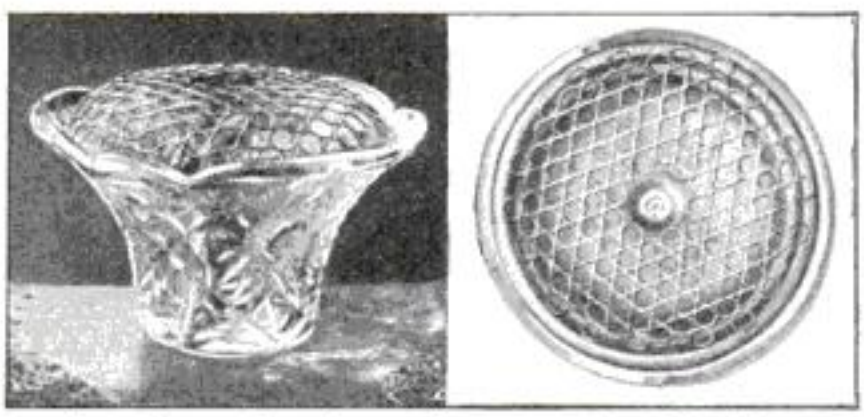
Qualities of Steel and Wrought Iron for Plumbing

STEEL and iron pipes corrode, but tests show that steel pipes corrode far more quickly than those made of wrought iron. The metal used to make steel pipes is a low carbon steel, which resembles wrought iron in softness, except that it has more tensile strength and is purer in quality. It is the latter characteristic which makes it corrode more quickly than wrought iron. Wrought iron contains slag, which is a glassy product. This delays the corrosion to some extent. Wrought iron pipes have lasted more than twenty-five years, if properly protected from frost, while the steel ones corrode very quickly by the action of the chemicals contained in ordinary hydrant water.

Acid and alkali tests show that steel pipes corrode more quickly in salt water than iron pipes. In fresh water, the corrosion is greater for the steel pipe than the wrought iron. An acid test also indicates that the steel pipe is eaten away more quickly.—W. S. STANDIFORD.

A Screen Cover for an Ordinary Flower Holder

PLACING flowers in the ordinary vase bunches them so that they do not fall gracefully. A few flowers may be prettily displayed and made to look



Any jar or bowl may be covered with this screen made of rings soldered together

like a large bunch if each stem is placed in one of the openings in this screen-like covering for a bowl or similar container. Screens for this purpose may be purchased, but they are very easily made at home. I made the one illustrated from small brass rings which cost me only twenty cents. The manner of construction is as follows:

Select from the pantry, a small pot cover that has seen considerable service and that has no tin left on it. It should have enough curve to give it the desired shape. Turn the concave side of the cover up, and place one ring in the center, over the spot where the knob is riveted. Such a cover must have a metal knob as it will be subjected to heat. Around the center ring lay the other rings until the size desired for your screen is reached. Then solder the rings together.

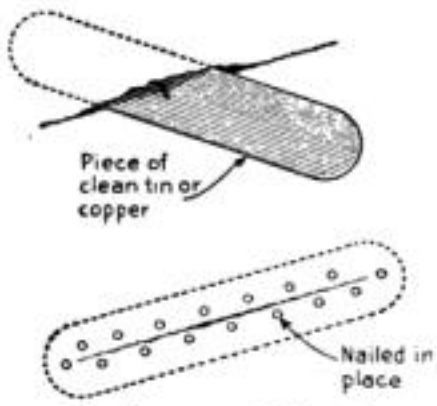
Procure some wire solder and acid; place a small bit of solder on the rings where they touch one another and put on a bit of the acid. When all joints have been gone over, take up the cover with a pair of pliers and hold it over a small flame so that it will be heated evenly and just enough to run the solder. Then take it where it will quickly cool. After cooling, it is ready for use. If it is desired to have a fancy screen, the cover can be plated in nickel, in copper, natural or oxidized, or in the more precious metals. If gold or silver is used, the home-made screen will be as expensive as a purchased one.—J. E. PETTIBONE.

Removing the Stains of Silver Nitrate From Cloth

WHEN using silver nitrate bath solutions in photography, the operator frequently stains his hands and clothing with the nitrate. It is not very generally known that certain chemicals will remove the stains, or will render them invisible. The following is applicable to clothing: Dissolve in water to a moderate concentration, bichromate of mercury, obtainable at drug stores, and moisten the spot with it until the stain becomes invisible. Or dip the fabric into a copper chloride solution until the stain has disappeared, and then wash it with a fairly concentrated solution of hyposulphite of soda, followed by a thorough rinsing in water. Or dissolve one part of mercuric chloride, and one part of ammonium chloride in eight parts of water and dip the fabric in the solution. To remove the stains from the hands, a cloth immersed in one of the above mixtures and rubbed on the stained portion of the hand, will usually serve. Some people use potassium cyanide, but the poisonous property of the cyanide makes its use dangerous.

Soldering a Crack in an Old-Style Copper Bathtub

SOMETIMES a heavy coating of solder is run over a crack in an old-fashioned copper bathtub, or other tank, sheathed in wood. Eventually the edges of a portion of the metal become corroded and through expansion and contraction of the metal, the crack extends up into the solder. To repair this properly, clean the metal thoroughly, then take a piece of clean tin or copper, wider and longer than the crack, and insert it in the opening as shown. Then work it around until it is in the position of the dotted lines. Fasten it with brass tacks or bright nails. Apply the soldering flux and run the solder, making it heaviest over the crack and the nails.—JAMES M. KANE.

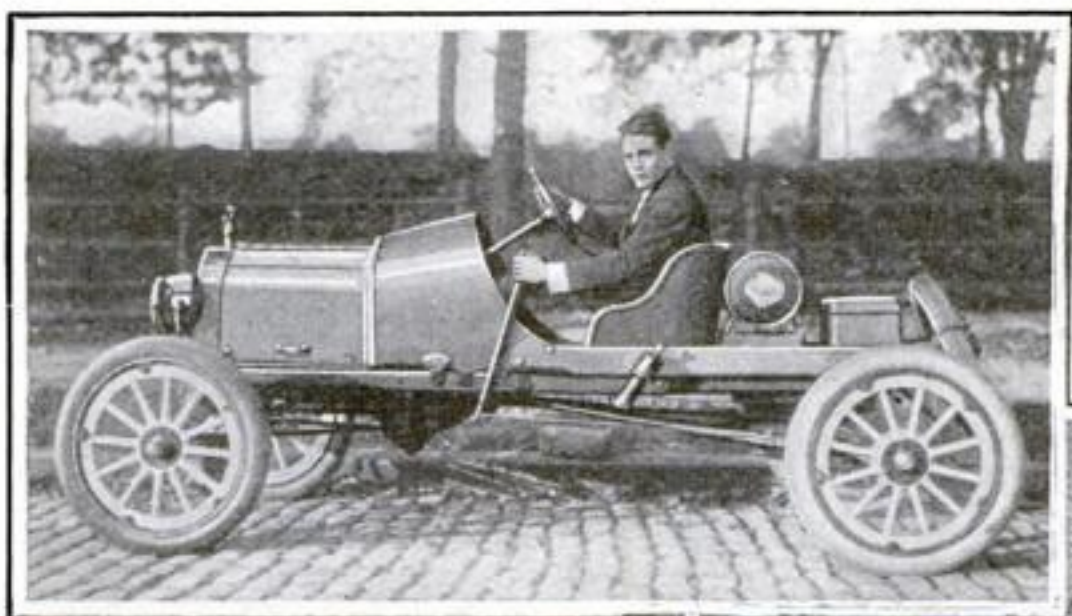


Placing metal strip back of break

Rebuilding a Wrecked Automobile To Make a Racing Car

THE owner of a wrecked car concluded it was only fit for the junkman and left it in the corner of his lot where it was hauled after the accident. The nephew of the owner decided that it could be made of some use, as the engine needed only a few new parts to make it like new. The cost of the materials he bought did not exceed $15.

The damaged body and mud guards were stripped from the chassis frame, and



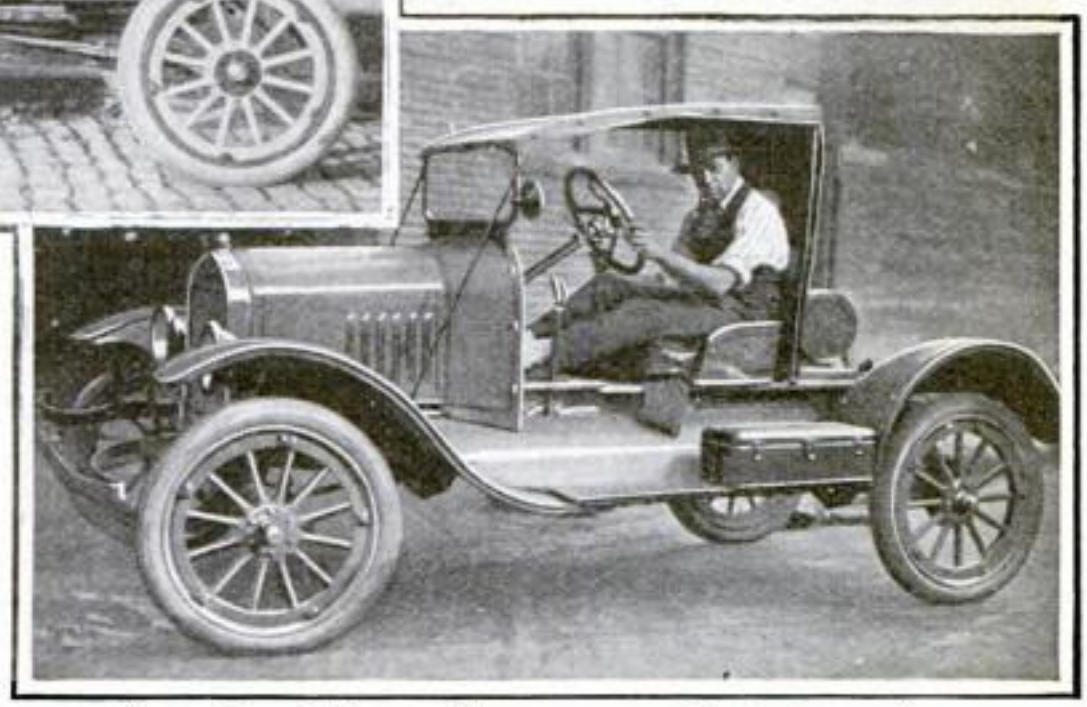
A built-over and refinished car that was once supposed to be wrecked beyond repair

the bent and damaged radiator was straightened and repaired. The gasoline tank was moved back 3 ft. from under the front seat, which left a space in which to lower the seat to the position desired. An extra piece of gasoline pipe bridged the gap made by moving the tank back. A floor was laid on with tongue and groove mast and bolted to the chassis. The length of the boards was kept the width of the chassis instead of extending to the wheels as in the old car. The steering wheel was then lowered. This was one of the most difficult parts of the work. A new hole was cut in the dash board 3½ in. lower, giving the wheel the correct angle from the low racing seat. The old seats were used, being cut out of the center to fit the seat to the narrowed car. The cut pieces were brought together and braced on the inside with four metal strips. To give a firm back support, the seat was braced to the floor with metal angles securely fastened.

The old tool box was tightly fastened in the rear of the gas tank, back of the seat, and used for an extra seat by placing cushions on it. The hood was first cut out from cardboard and then from tin and hammered into shape on a wooden block. This covered up brake pedal, clutch pedals, reverse pedals and protected the switch box. The result, after the car had been painted, can be seen in the upper illustration.

Carefully look over a supposedly wrecked car before selling it for junk, for the engine may still be in perfect order, or unharmed to such an extent that with slight repairs it can be put in shape for further use in an automobile, or for a stationary power plant. Some other parts may be used in rebuilding another car.

Another transformed car is

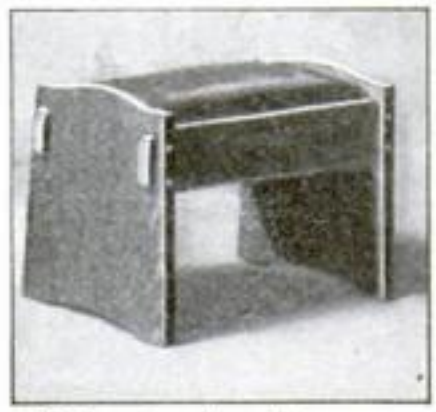


A semi-roadster and racer was desired, so the car was specially built on a new chassis

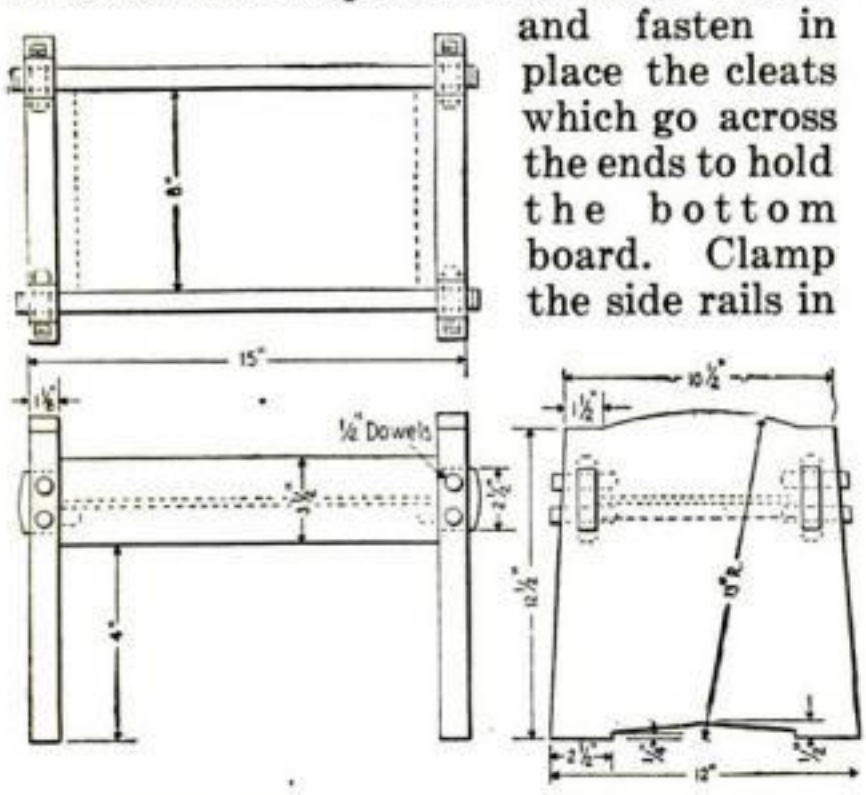
shown in a second photograph. The owner of this car was not trying to save money. He merely desired a car made according to his own ideas. In this case, a new chassis was purchased, including mud guards, tool box, gas tank and headlights. He floored the chassis, put in two separate seats made according to his own design, and fitted the car with a top of light awning construction, with iron piping screwed to sockets in the floor, removable at will. For the top, brown canvas was used. The wind shield was reduced to half size to conform to the shape of the car. This car is half roadster and half racer.

Making an Oak Footstool in Mission Style

THE footstool shown, differs slightly from the conventional style. It is thoroughly practical and is easy to make. Made in oak, it is a serviceable and pleasing piece of furniture. Select choice material. The ends are cut first. Lay them out carefully, drawing the mortices on both sides so that both sides can be cut. This ensures a neater and more accurate job. Cut the outline of the ends on a bandsaw, following the line closely. The mortises are then cut, working from both sides. After these are ready, smooth the edges; the straight edges with a plane and the curves with a wood file. The side rails are next planed to width and the ends fitted to their respective mortises. Make and fasten in place the cleats which go across the ends to hold the bottom board. Clamp the side rails in place as they are to be in the finished piece. Next bore the holes for the ½-in. pins. These pins are cut from the left over scraps of wood. Apply glue in the holes and drive the pins in place. The heads of the pins can be finished with a rounded, flat, or pyramid point as the taste may dictate. Finish the stool with a good standard oil stain.



The stool as it appears when finished



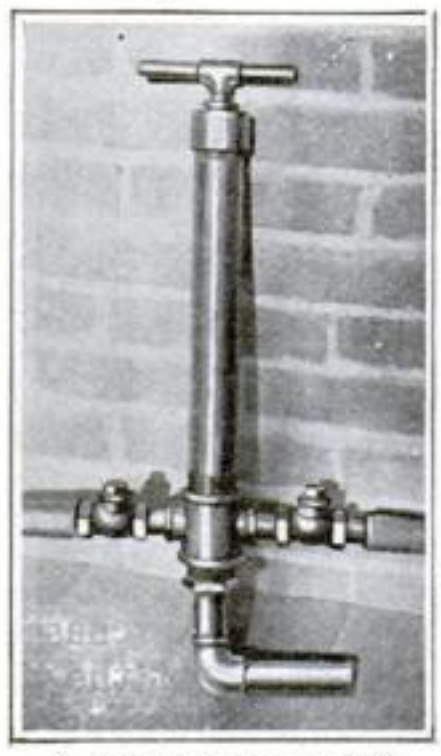
Details of the oak pieces which enter into the construction of the mission footstool

Asbestos Used in Place of Copper for Laboratory Hoods

IT has recently been found that asbestos can be substituted for copper in constructing the flue pipes for the hoods, in chemical laboratories. It had formerly been thought that nothing but heavy sheet copper would withstand the corrosive action of chemical gases and fumes. The present high price and scarcity of copper, however, has made a substitute almost imperative and in constructing some new laboratories in Brooklyn, application was made to a large manufacturer of asbestos products, for asbestos flue pipes. As a result, pipes square in cross section and consisting of asbestos board ¼ in. in thickness were made and installed. These pipes are gas tight and as asbestos is entirely unaffected by corrosive gases, they will undoubtedly last a life time.—FLOYD L. DARROW.

How to Make a Force Pump of Pipe and Fittings

WITH a few pipe fittings and pieces of pipe a very serviceable force pump can be constructed that may be used to open up drains, water pipes and the like. The main pipe or pump barrel consists of a piece of brass pipe into which a piston is fitted snugly. This piston is operated with a small pipe, having a crossbar made of a tee and two pieces of a pipe at the upper end for a handle. The long pipe to which the piston is attached runs through a packing nut fitted into a pipe cap which covers the pipe end. The lower end of the barrel screws into a reducing cross, having connection as shown. Two check valves are attached to the side nipples. Water may be supplied from either or both sides.—C. H. THOMAS.



A force pump made of pipe and fittings

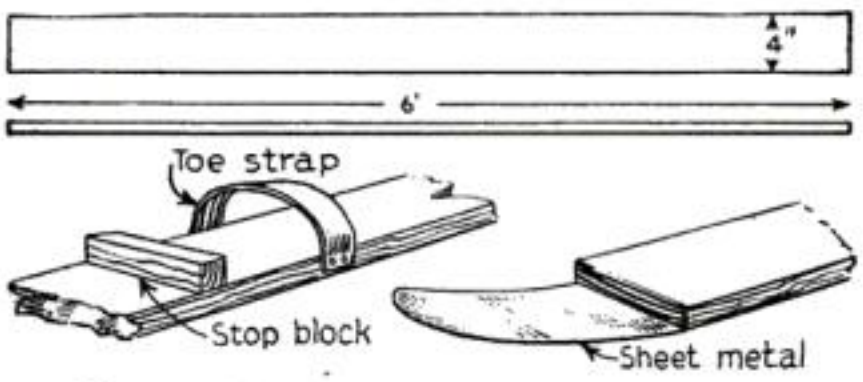
Homemade Pair of Skis

A simple method of making skis without having to bend the wood

BY following the design here illustrated, it is comparatively easy to construct a pair of skis with which one can travel on the surface of the softest snowdrift without sinking.

Procure two hardwood boards about 6 ft. long, 4 in. in width, and ½ in. thick. Although soft wood will do, hardwood will answer the purpose better, as it polishes easier, and the smoother the ski is on the bottom the better it will run.

A leather strap is tacked to the upper side of the ski, so as to form a loop. This should be placed exactly in the center of the ski and should be just large enough to admit the toe of the shoe. A small block of wood is fastened just back of



The straight wood runner is pointed with a piece of sheet metal curved at the end

the toe-strap in such a position as to fit into the hollow part of the shoe, just in front of the heel.

A piece of heavy tin or sheet metal is used for the front part of the ski. This should be about 1 ft. long, 4 in. wide at one end and tapering to a blunt point at the other. It is fastened to the under side of the front of the snow-shoe, with the pointed end turned up. The nail heads and all sharp points of tin should be filed off so as to make the under surface of the ski as smooth as possible.—PETER J. M. CLUTE.

How to Make Knitting Needles in a Speed Lathe

KNITTING for our soldiers seems popular with the ladies as a method of doing their bit. It may be of considerable interest to know that knitting needles can be made easily and cheaply by students, in shops where speed lathes are available.

Red cedar is the best wood to use. Secure straight grained sticks and joint them straight and true. Rip out pieces about 1 in. longer than the length desired, and with a side of the cross section only slightly greater than the required diameter of the needle.

Needle sizes are about as follows:

For sweaters, dia. 200 in., length 14 in., Twist drill No. 7.
For helmets, dia. 175 in., length 13 in., Twist drill No. 16.
For wristlets, dia. 135 in., length 12 in., Twist drill No. 29.

Secure a piece of cold rolled steel ½ by 2 by 5 in. and drill a hole in the center of each end, in such a manner as to allow it to be bolted to the face plate of a speed lathe through the screw holes on the face plate. It should approximately center up on the lathe. With a twist drill of the size of the needle required, drill a hole

through the piece of steel while the lathe is running. Countersink the face of this hole.

Clamp a jack plane, bottom up, in a vise and run the cedar sticks across the plane to remove the corners.

Start the lathe on high speed, and then feed the cedar sticks through the hole in the piece of steel. A little pressure may be required, but if the pieces are not too large, they will feed through nicely and leave a well finished surface.

To make the heads or knobs, rip some cedar into pieces slightly greater than $\frac{3}{8}$ in. square and about 42 in. long. Drive these through a $\frac{3}{8}$-in. dowel plate. Fasten a piece of pine about 2 in. thick to a face plate, and, while the lathe revolves, drill a $\frac{3}{8}$-in. hole through the center of the pine chuck. A $\frac{3}{8}$-in. drill is best, but a $\frac{3}{8}$-in. auger bit will do. Chuck one of the $\frac{3}{8}$-in. pieces of cedar in the hole in the pine piece. With a drill the same size as the needle, drill a hole through the center of the cedar as the lathe revolves. Next, remove the cedar from the chuck and cut it into $\frac{3}{8}$-in. lengths. Glue one of these lengths on one end of the needle. When dry, chuck the needle in the hole in the steel plate (a little shellac will hold it) and turn the head down. The needle may be sanded lightly by allowing the free end to turn in the palm of one hand as the lathe runs, and by applying the sandpaper with the other hand.

The needle may now be cut to length and pointed on the side of an emery wheel, or on a revolving disk of sandpaper, glued to a chuck. French polish the needle by hand, with a little shellac and a drop or two of linseed oil. The varnish may be rubbed in with a piece of cheesecloth.—DANIEL GREEN.

Making a Lock Washer from a Coil of Spring Wire

A GOOD lock washer for emergency use can be made by cutting a single coil from a compression spring. This will have the "set" of a regular lock washer. The only difference is that the washer is made of round instead of flat stock. An added point in favor of this device is the ready availability of springs.

A Heater for the Sidecar of a Motorcycle

A HEATER for a sidecar can be easily made from a tin can—a gallon oil can will do—and a flexible tube, such as is used to supply warm air to the carbureter in automobiles. Cut a round hole in one side of the can, and in it fasten a tube, which passes through the floor of the car, to serve as the exhaust outlet for the gases.

An old can used to heat a sidecar

One end of the flexible tube is slipped over the filler nozzle of the can and clamped in place with a hose clamp or a wire wound around it and twisted tightly. The other end of the tube is fastened to the tail pipe of the muffler in the same way, a hole being cut in the side of the sidecar allowing the tube to pass through. If some covering, such as a storm apron, is used, the car will be as warm as desired, even in the coldest weather.—N. DRYNAN.

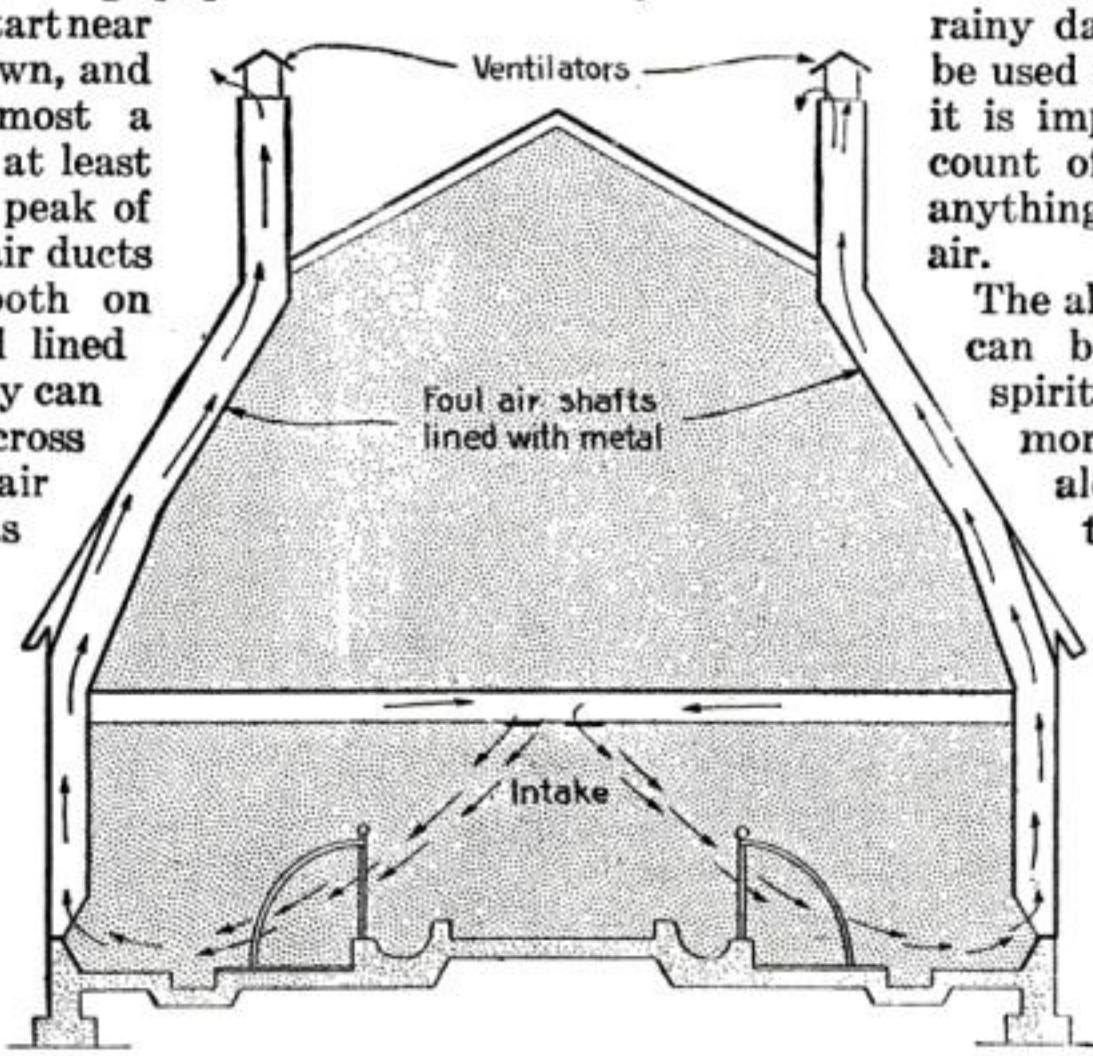
Caring for Rubbers to Make Them Wear Longer

RUBBER overshoes, like everything else just now, are expensive, and sometimes hard to get at any price. Any suggestion as to how to make them last longer, will, therefore, be appreciated. If you will give them a little extra care and attention you will be more than repaid for the trouble.

All oils, fats, milk or acids will cause rubber to blister, soften and wear out quickly. Therefore keep them away from your overshoes. When soiled, wash the rubbers with lukewarm water. Do not put them near a hot stove or steam pipe, as the heat will make them crack. Do not leave the rubbers outside of the house, exposed, for sunlight will heat and crack them. Freezing will also make them brittle, so that they are likely to crack when they are put on. Of course it would be rank foolishness to try to wear high heeled rubbers on low heel shoes, or low heeled rubbers on high heeled shoes. In either case, the rubbers would very soon break out at the heel.

A Practical Ventilator for the Dairy Barn

THE essential points required for obtaining the best results with this system of ventilation are: The stable room must be as nearly weather-proof as possible. To keep out the cold air, insulate the walls and ceilings with matched lumber and building paper. The foul air-vent shafts start near the floor, as shown, and run up in almost a straight line to at least 2 ft. above the peak of the roof. The air ducts should be smooth on the inside and lined with metal. They can be circular in cross section, as the air goes in spirals, as in windstorms. Sharp bends in the shafts must be avoided as often as possible. The top of the shaft should be rain-proof.



Positions of ventilator shafts in a dairy barn to provide a means of admitting fresh air and of removing the foul air without drafts

These shafts may be covered with the ordinary stationary or revolving ventilator such as is used on smoke stacks.

Fresh air ducts open into the ceiling of the stable, directly over the cows' heads. Make the air intakes in the outside walls as far below the outlet at the ceiling, as is practical. It is well to do this, because if the intake is level with the outlet in the ceiling, the warm air near the ceiling will escape, reversing the flow of air and exhausting the heat instead of letting in fresh air. Fresh air ducts give satisfaction when evenly distributed in front of the stock, while the foul air ducts can be made large and fewer in number.

The sketch shows how this practical and well-tried system works when the cattle in the stable face the center of the barn. It is inexpensive to install in new or old barns.—W. E. FRUDDEN.

Making Briquettes for an Alcohol Stove

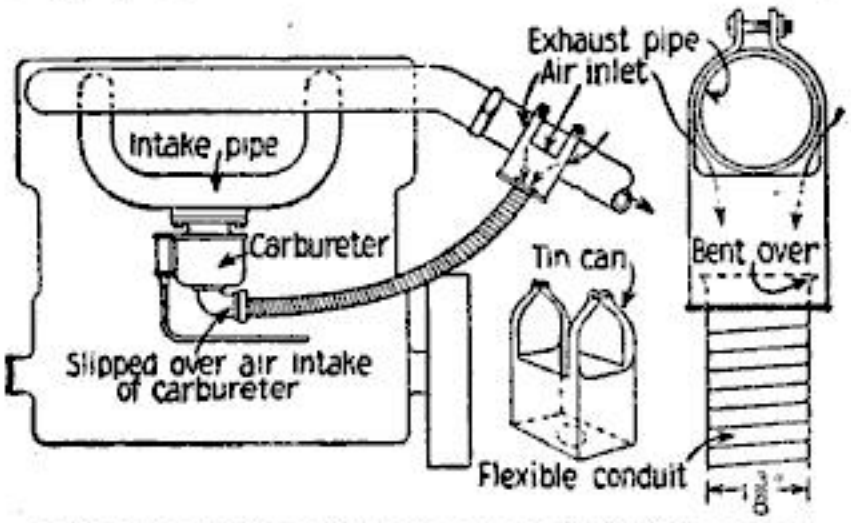
IN drug stores and at stationers are seen small stoves that use briquettes of solidified alcohol for fuel. These stoves are very useful for boiling coffee, cocoa or for other purposes where an intense heat is desired. They are also very convenient for campers use on a rainy day, as they can be used in a tent, when it is impossible on account of rain to cook anything in the open air.

The alcohol briquette can be used like a spirit lamp, and it is more handy. The alcohol lamp has to be carried in an upright position to keep the contents from spilling; while the briquette is fluid only while it is burning. When not in use, it solidifies and can be carried in any position.

The yellowish, doughlike substance is easily prepared. It is made as follows: In a vessel of suitable size and kind, 1,000 parts of denatured alcohol are heated by a water-bath. When the fluid reaches a temperature of 140 deg. F., 35 parts of dried and grated Venetian soap and 2 parts of gum lac are added. The fluid is then stirred until the substances are completely dissolved. Then the mixture is poured into empty baking powder boxes, or if a person has a briquette stove and has saved the cans, the mixture can be used to refill them. On cooling, the mixture solidifies in the cans. In these stoves, the flame is extinguished by replacing the lid. The contents can thus be preserved until the alcohol in the mixture is exhausted. Do not use wood alcohol in making the substance, as its fumes are dangerous.—W. S. STANDIFORD.

Homemade Hot Air Intake for a Carbureter

TO increase the mileage per gallon of gasoline, the air should be slightly warmed before it enters the carbureter. A very simple and practical method of supplying this heated air is shown in the



Tin can on the exhaust connected with metal pipe to supply hot air to the carbureter

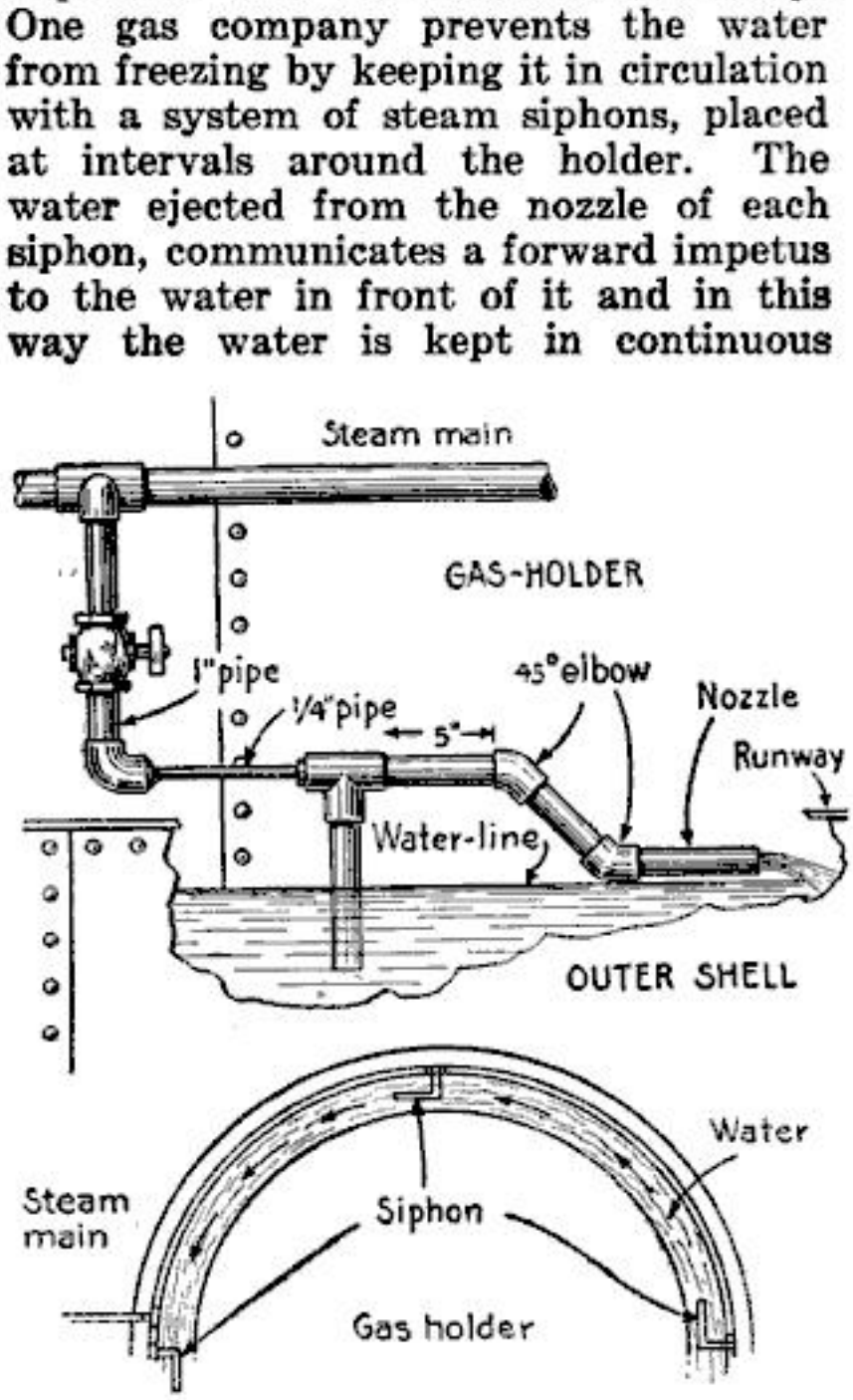
illustration. The main body of the device consists of an oblong tin can cut out and fitted over the exhaust pipe, as shown. A hole is cut in the bottom of the tin can and the end of the piece of flexible metal pipe, such as is used for electric wire insulation, is slipped into it and connected with the air-intake of the carbureter. This is a satisfactory homemade accessory which will give more miles to the gallon of gasoline, quicker acceleration and less carbon.—P. P. AVERY.

Adjusting the Foot Pedal to Prevent Wear on Gears

IT may be difficult to believe that the adjustment of an automobile clutch pedal has everything to do with the life of the transmission gears and the clutch parts. If the pedal is set so that it moves through a greater part of its arc before it commences to release the clutch, then it is more than likely that it will not wholly separate the clutch members. In that case, the gears will clash in "changing" and they will be prematurely worn out. Besides "changing" will be a noisy operation. If the pedal is set so that when it is "back" it strikes the floorboard, it is almost certain that the clutch members are not engaged as tightly as they should be and that they are slipping—though so slightly as not to be noticed—with a consequent wearing of the surfaces. Worse than this, the clutch is being held "out" all the time against a powerful spring, and the part that takes the thrust of this spring at such a time, is an expensive ball bearing, which is sure to show the effects of such service.

Circulating Water in a Gas Holder to Prevent Freezing

THE ordinary observer would think that a gas holder is sturdy enough to be unaffected by freezing water. But the fact that the upper drum, holding the gas, is surrounded by, and moves up and down in water, renders it necessary for the gas companies to safeguard their holders against freezing, as it is vitally important that the holders move freely. One gas company prevents the water from freezing by keeping it in circulation with a system of steam siphons, placed at intervals around the holder. The water ejected from the nozzle of each siphon, communicates a forward impetus to the water in front of it and in this way the water is kept in continuous



Siphons made of gas pipe and operated by a steam jet to keep water in circulation around gas holder. This prevents freezing

movement around the holder. The siphons are built of 1-in. pipe excepting a short piece which is made of 1¼-in. pipe. The steam main is, of course, the largest.—JAMES M. KANE.

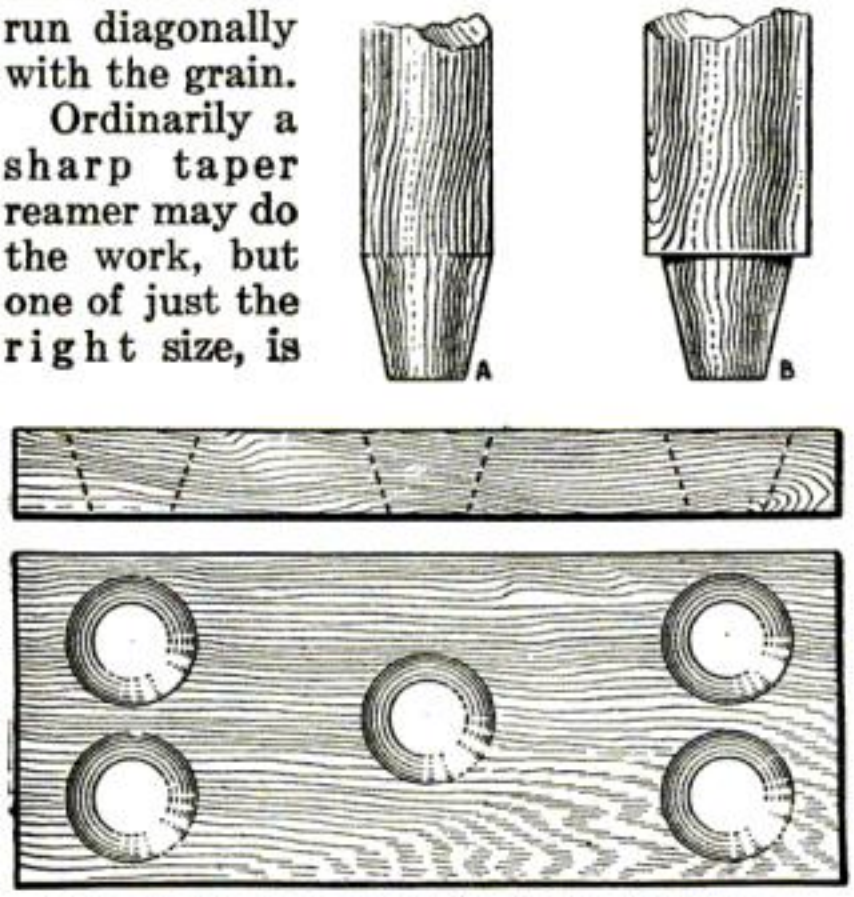
Tricks of the Trade

Under this head each month there will appear one or more articles describing methods and short cuts in shop work practice

Burning Holes in Patterns

PATTERN makers and other wood workers are often at their wits end to find a way to make smooth, tapering holes, especially in a piece of wood which is cross-grained, or in which the hole has to run diagonally with the grain.

Ordinarily a sharp taper reamer may do the work, but one of just the right size, is not always at hand, and when a hole of a particular size and bevel is required, the taper reamer will not do the work.



Tapered holes accurately sized by burning with wood points rapidly revolved in them

On a job recently, there had to be five smooth holes, of the same size and bevel, through a piece of $\frac{5}{8}$-in. whitewood. The holes were $\frac{5}{8}$ in. at the small end, and 1 in. at the large end. They were bored with a sharp bit, a little smaller than they were to be at the small end, then beveled with a sharp knife to nearly the size at the large end. A piece of hard wood was then turned to nearly the size and taper required, as shown at *A*. This was revolved at medium speed in each hole until it burned a little. Care was taken not to let it burn too much. This was repeated until the holes were almost the size and bevel required. Next, another plug *B* was turned the exact size the holes were to be when finished. Then the holes were carefully finished with this.

It is a good plan to turn a shoulder on the finishing plug so that the holes may be just alike. Finish the holes with fine sandpaper.—C. E. STONE.

Tempering a Chisel to Cut Stone or Bricks

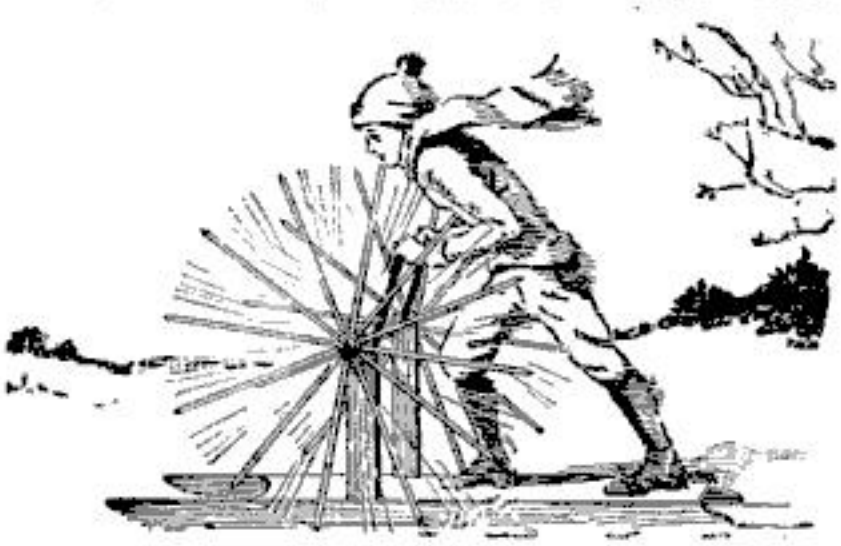
A CHISEL to cut stone masonry work must be tempered to a different degree of hardness than those to use for other work. Before tempering, it should be sharpened on an emery wheel, as tempering puts a hard surface, or a sort of skin, on the cutting edge, which grinding removes to a certain extent, no matter how carefully the grinding is done. In grinding stone cutting tools, do not grind the cutting edge with too narrow an angle, but allow the edge to have an angle of over 100 deg. This gives a sufficient amount of metal back of the sharp edge, to enable it to withstand the shock of the blows. Too sharp an angle on the tool edge would cause it to break at the first blow. After the grinding is done, put the chisel into the fire and heat it to a cherry-red color, then dip the point of it into cold water—holding the chisel in a vertical position. Do not dip it all in, but leave some heat in the shank. Quickly brighten the point with a file or emery cloth and watch the colors closely as they travel down to the point. When a light-blue is reached, dip the entire chisel into cold water. It is then ready to use.—W. S. STANDIFORD.

Mercury Used for a Thrust Bearing on an Upright Shaft

A NEW bearing is being used on a generator set, wherein the main shaft stands vertically and supports considerable weight. Instead of being supported by collars or an end thrust bearing, a small quantity of mercury is placed in a pocket at the lower end of the shaft.

Hand Sled Propeller Made of Discarded Buggy Wheels

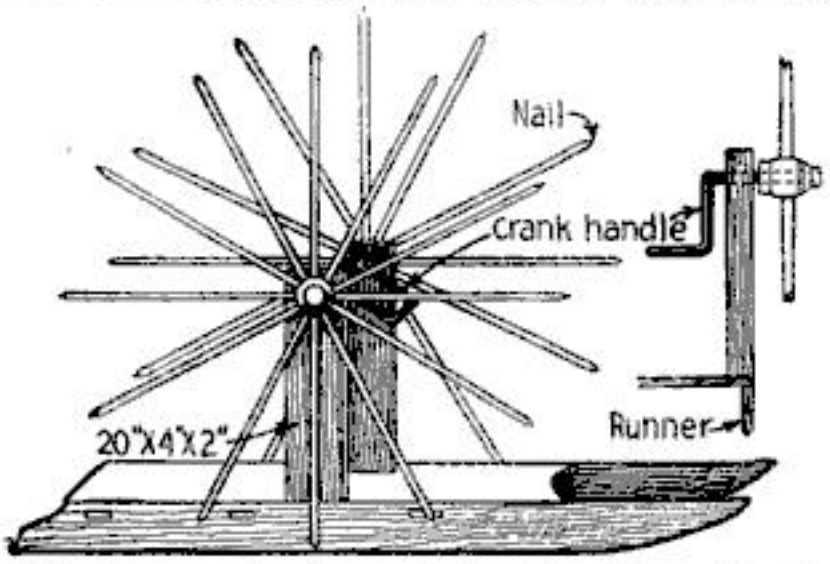
FOR ice and smooth, level, well packed snow, this is a very fine sled propeller. It is made of two old buggy wheels with the spokes sawed off just where each one enters the felloes. The



Propelling the sled over smooth snow and ice by turning the shaft between the supports

axle holes in each hub should be plugged with wood.

For a shaft, take a ½-in. rod and bend it in the form of a crank. To support this shaft, two hardwood pieces 20 in. long, 4 in. wide and 2 in. thick are needed. These support posts should be fastened to the top of the sled by means of screws. A ½-in. hole, bored through the top of each, should be slightly reamed out with a hot iron in order to make a suitable bearing for the shaft. When the shaft has been placed, the wheels should be



The buggy wheels are fastened on the ends of a shaft bent to form a crank in the center

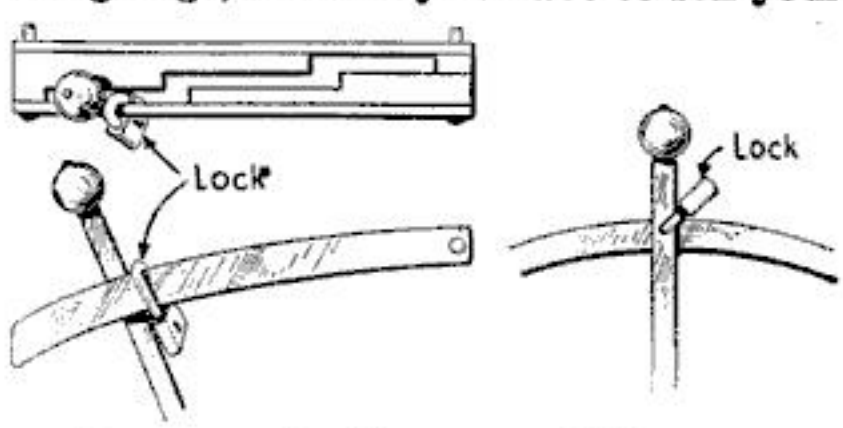
fastened in place on either end of the shaft. This is done by driving each end of the shaft into holes bored through the wooden plug in each wheel.

The end of each spoke should be sharpened and an 8d. finishing nail driven in up to the head. By using a file, this head may be sharpened to a point. Thus the nail heads will do the pushing without allowing the spokes to slip on a smooth surface.

It is evident that when a boy, sitting on the sled, turns the crank, the wheels will revolve, thus easily propelling the sled over the ice or snow.—F. E. BRIMMER.

The Most Convenient Way to Lock a Motorcycle

IF it's a three-speed motorcycle that you have, simply lock the gear-shifting lever in neutral position by snapping your lock in the guide-slot. This method has the advantages over the ordinary scheme of chaining and locking the wheels, in that you will have no difficulty in moving your machine about in the garage, nor will you have to soil your



Two ways of locking a gear shift lever on a motorcycle to prevent its being stolen

hands while putting the lock either on or off. This same principle can be used if you have a single-speed cycle, by drilling a hole through the lever and the guide-bar, so that the lever can be locked when in the "free" position. Always remember that it pays to buy a good lock.

How to Straighten a Bent Rim on a Headlight

LAMPS are about the first part of an automobile to sustain an injury in a wreck or accident, as the spun metal is very thin and will become dented with a slight blow. Dents on the rims or other parts of the lamp may be straightened as follows: Take the other lamp and pour melted babbit metal into the part that is bent in its mate. When the metal has cooled, it is used as an anvil to straighten the bent part. For hammering the metal, use a rubber or soft faced hammer.

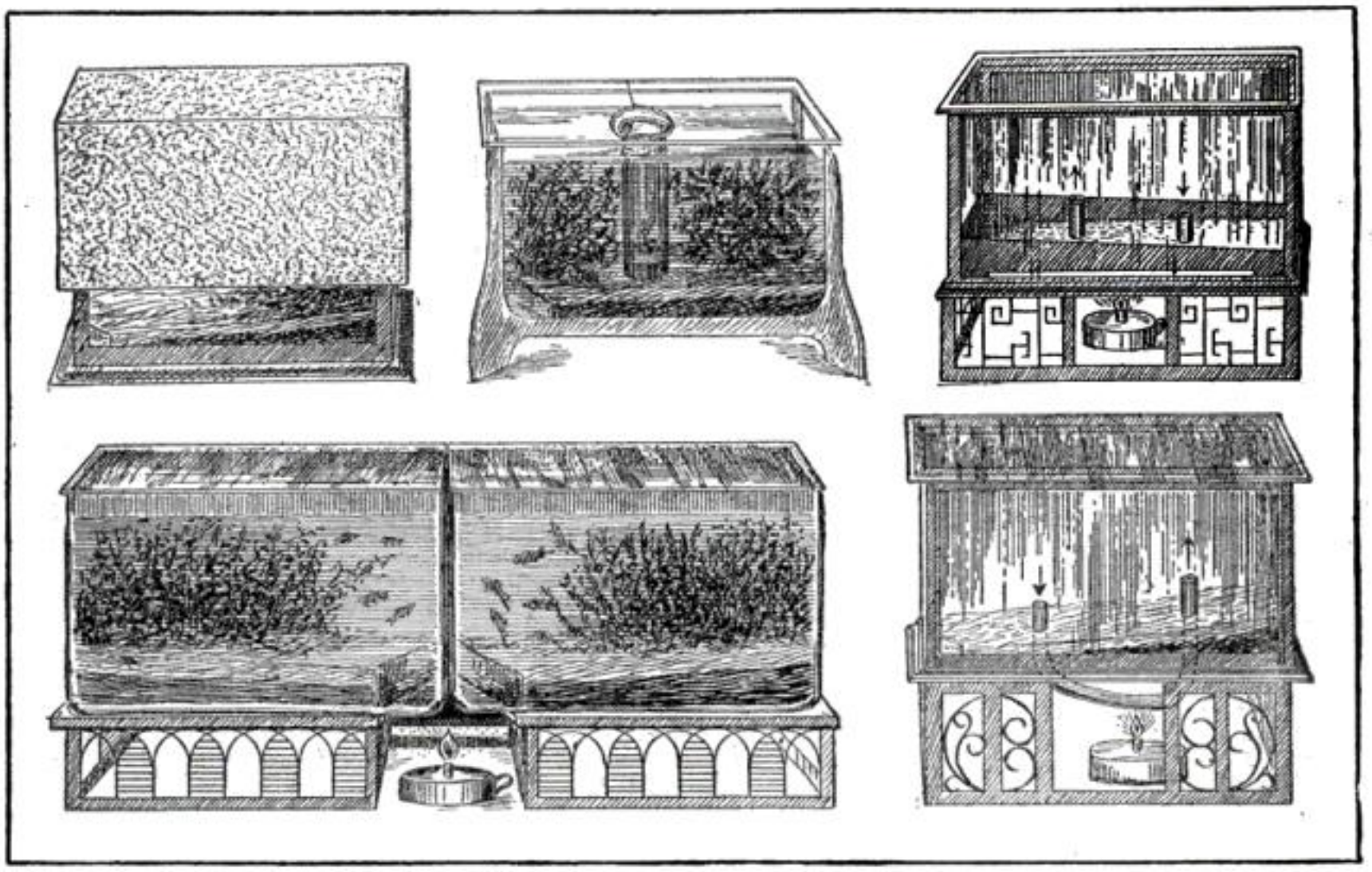
How to Make an Aquarium for Tropical Fish

ORNAMENTAL tropical fish which are kept in cool or cold water during the winter do not show their gorgeous color effects. Their appetites are not what they should be and the fish are slow of movement and lazy in actions. Their liveliness leaves them. No longer do they disport themselves as is their wont in warmer waters and they rarely multiply in this, the best season of the year, winter.

Tropical fish require a temperature of at least 60 deg. F. To keep the water at this temperature in winter, especially designed aquariums are built. But ordinary aquariums may easily be adapted to give equal satisfaction along these lines.

If one of these simple aquariums stands in a room which is heated during the day, no complicated heating system need be used to keep the water at a constant temperature during the night. A cardboard box, large enough to completely cover the tank is placed over the aquarium at night. The sides of the box should reach to the bottom of the aquarium and leave no more than ⅛ or ¼-in. play on either side. This is a device which will suffice in most cases, as it effectually keeps the water at the required temperature. In the morning the cover should, of course, be removed.

Heating the water of the aquarium directly, will give better satisfaction than the above mentioned method. An apparatus with which to do this, besides being more efficient and easy to install in almost *all* aquariums, has the advantage of being absolutely fire proof. This device consists of a tall, not too narrow, cylindrical glass jar placed in the water of the aquarium. This jar is filled with lamp oil and lighted with one or more Nürnberger night lights which consist of a wick dipped into paraffin. It is held erect by a wire, radiating outward and the whole apparatus is supported by three corks to which the wires are attached. If these lights refuse to burn in the glass, a small tubing of either rubber or glass is inserted to insure fresh air reaching the wick. Although a large quantity of heat is lost by this method, it is absolutely safe and no accident can ever result from it. Electricity may



A cardboard box covering for an ordinary aquarium at night. An aquarium heated with a candle lamp which is placed at the bottom of a glass tube set in the water, and which applies heat from beneath the receptacle. Also methods of heating an aquarium with inclosed tubes

be substituted for the lamp oil, if a bulb is placed in the jar.

The other methods of heating the aquarium differ from those just described in that a lamp is placed beneath the tank, which must stand upon a platform or framework of artistically designed ironwork. But only those aquariums may be so heated which are either built entirely of glass or those which have zinc bottoms. Both are placed in pairs with their refuse corners facing each other. Those made entirely of glass receive an extra piece of copper placed about an eighth of an inch from the glass bottom which the flame must strike. Aquariums with sheet metal bottoms do not need this extra piece of copper, when this method of heating is used.

Two other ways in which the aquarium may be heated, remain to be explained. Both work on the principle of water circulation. This method produces the best results, for none of the heat is wasted. One of the tanks receives a small box-like insertion, made of sheet zinc, which should cover the bottom of the tank. Two tubes, one shorter than the other, are soldered to the top of the box. The tank may then be arranged like an ordinary aquarium so that only these tubes, covered with fine wire netting, project out of the sand. The water, in the box immediately below the soil of the aquarium, is heated with a small lamp. The water, as soon as it becomes warm, rises through the long tube, while the shorter one lets the cold water sink into the box. In this way, a continuous circulation is kept up. Another advantage of the box is that it does not heat the soil of the aquarium, which would materially injure the plants.

The other and last method is similar to the preceding one. Instead of the box, a U-shaped piece of tubing is soldered to the bottom of the aquarium. The curve, which projects about an inch below the aquarium, is heated. All heatable aquariums should be covered with a piece of glass when heated, unless a glass jar is used. Then the protecting glass cover should have a large opening, corresponding to that of the jar, and it should be so situated that the heated air may escape and a fresh cool supply reach the flame.—Dr. E. Bade.

A Secure Fastening for an A-Shaped Sign

LUNCH room and other sidewalk signs in the shape of the letter A will not stay in place on a windy day. Devices which might hold them steady are usually inconvenient to pedestrians. But with the fastening shown in the illustration, the holding device at the base of the sign may be set below the surface of the walk, where it will be in no one's way. When the turnbuckle is tightened, the sign cannot be blown away. The eye may be on a stake driven into the earth where sidewalks are placed on the ground, or where a sign is used outside of the walk; but in the case of a cement walk, the eye may be set in the gravel or grout when the walk is laid. The holding device may consist of a chain or of a rod with an ordinary turnbuckle in its center. The chain or rod is attached under and at the top of the boards and has a hook at the lower end for making connection with the eye in the walk.—G. P. Lehmann.

Bolt with turnbuckle fastened in sidewalk

Using Shingles to Make a Thatch-Like Effect at Eaves

PROBABLY every artistic soul has longed for a little home with droopy roof lines that stoop to meet the climbing ivy on the walls. You can go a long way toward getting it by making a bouquet of your shingles. Bore a hole through the first bunched line of shingles extending over the eave, and wire them in place. Of course it is necessary to slope the rafter ends and to put on the first sheathing board at a slope which will take the bunched shingles.—W. B. Smith.

Shingles bunched to make the thatch effect

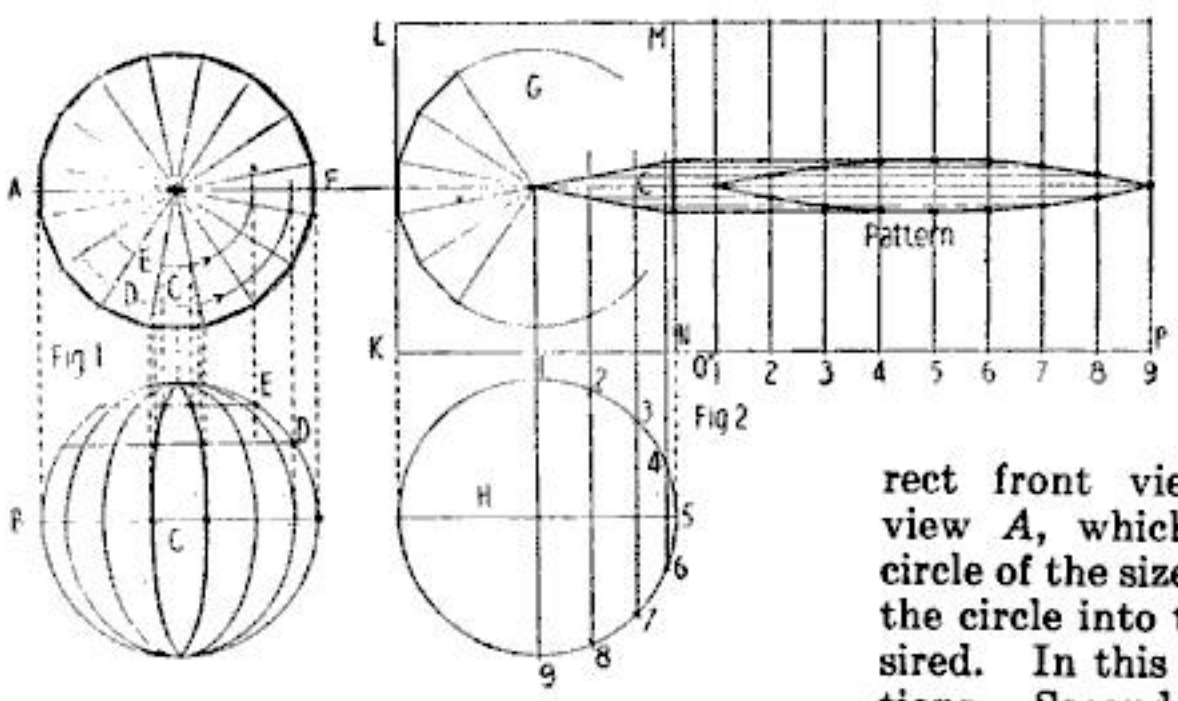
Simple Designs for Sheet Metal Working

IX.—Development of patterns for approximate spheres

By Arthur F. Payne

Former Director of Vocational Education, Columbia University

THE name "Approximate Sphere," given to the problem illustrated, will very likely need explanation to some of the readers of this series. The common names for this problem are "Gored Ball" and "Slab-sided Ball." A sphere is an object that presents a perfect circle from all points of view. The sphere, shown in Fig. 1, presents a perfect circle from the front view only, the top view is an "approximate circle," that is, it is almost a circle, being divided into sixteen parts, which are variously called gores, slabs, panels or sections. In this article, these parts will be called "sections," as this is considered the correct name.



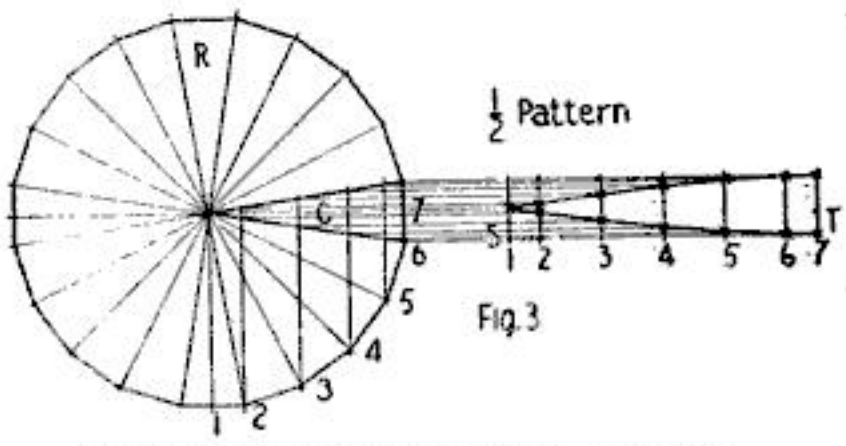
A "slab sided" ball is an appropriate ornament as a finial on top of a flag pole, steeple or turret

The practical application of the problem would be as a finial on top of a flag pole, steeple or turret, or as an ornament on buildings.

The interesting feature about this problem is that the methods used are the same as those used in the elbows and tee joints, illustrated in previous numbers. In fact, to develop the pattern for one of the sections, we must first of all recognize the fact that each section is merely part of a cylinder or pipe. This may seem somewhat difficult to see at first, but as the directions are followed and the pattern is developed, it will become clear. This particular point is illustrated by *G* and *H* of Fig. 2.

There are several different methods of developing the pattern for this problem. For the sake of better understanding and practice, three methods are illustrated. However, as they are worked out, it will be seen that they are all based on the same principle.

The method of obtaining the correct front view of the sphere is shown in Fig. 1. This is not absolutely necessary to the development of the pattern, but is given because it is often useful in making a sketch for the customer. To get the correct front view; first, draw the top view *A*, which is done by drawing a circle of the size wanted and then dividing the circle into the number of sections desired. In this case there are sixteen sections. Second, draw the front view *B*. This presents the problem of drawing the true picture of the section *C*. We can very easily get the width at the widest part by dropping down the dotted lines as shown in the drawing, but we have to find some way of drawing in the curved line to complete the section from the front view. This is done by drawing the arcs *D* and *E* on the top view. This is for the purpose of locating points on the

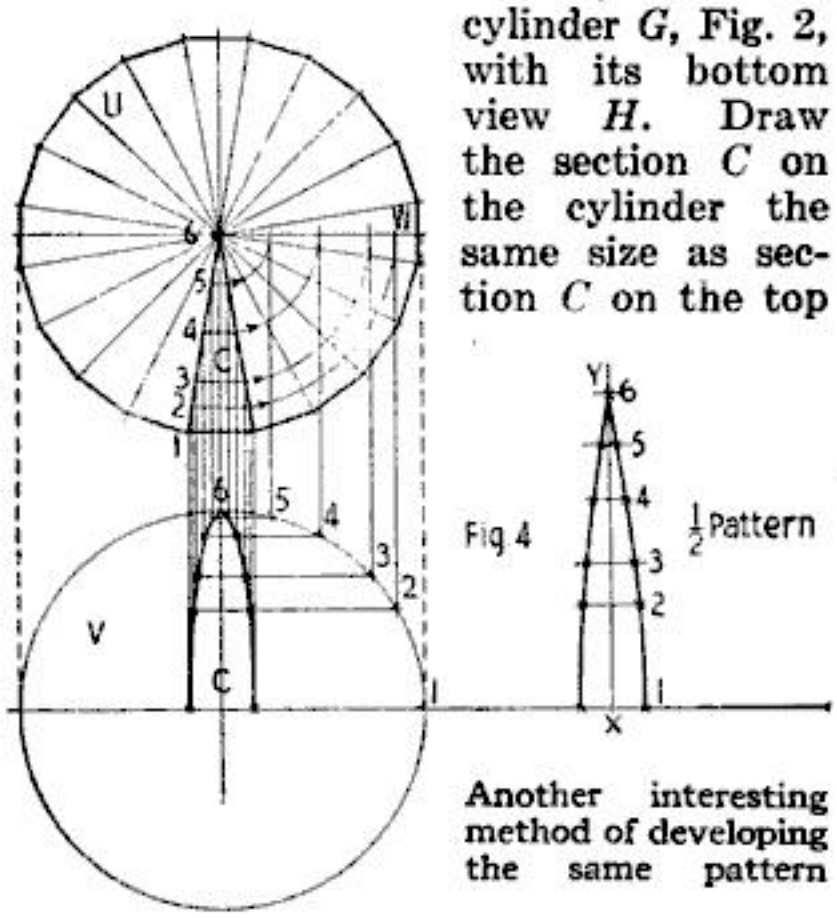


A short cut method in which no bottom view is required for obtaining pattern

section *C* so that we can get the correct widths down to the front view. The arcs *D* and *E* are swung up to the line *F* and then dropped down (see dotted lines) until they strike the edge of the sphere on the front view, as indicated by the crosses. Next, run the lines *D* and *E* across the front view. Then drop the dotted lines from *D* and *E* on the top view down until they cross the lines *D* and *E* on the front view. Connect these crosses with a curved line and you have the true front view of the section *C*.

Developing the Pattern

The development of the pattern for the section is as follows: First, draw the cylinder *G*, Fig. 2, with its bottom view *H*. Draw the section *C* on the cylinder the same size as section *C* on the top



Another interesting method of developing the same pattern

view of Fig. 1. Now, if the rectangle *K-L-M-N*, Fig. 2, is thought of as representing the front view of a cylinder, or round pipe, it will be seen that the section *C* is simply a slice of that cylinder. After this is seen, the problem becomes a very simple one in which we use exactly the same methods of development as we used in the elbow patterns. Second, draw the bottom view *H*. Divide one-half into eight equal parts. We only use one half because the section only runs half way round the cylinder. Third, draw the base line *O-P*, obtaining the correct length by stepping off the eight spaces from the bottom view *H*. Run the lines from the points on the bottom view upward until they strike the section *C*. Then run them over until they intersect the same numbered line coming up from the base line *O-P*. Make a cross at the point of intersection and connect with a curve. Then you have the complete pattern for the section *C*. Cut out sixteen of these. Bend them to the form of a half circle and solder them together. No allowance is necessary for laps or seams.

A "short cut" method is shown in Fig. 3, in which the top view corresponds to *G* in Fig. 1. No bottom view is needed because the lower half is used as the bottom view, and the section division lines designate the bottom view points. Lay off the base line *S-T* by stepping off the distance as numbered. Run the lines upward until they strike section *C*; then over to the right until they cross the same numbered lines coming up from the base line. Mark the intersection with a cross. Connect these crosses with a curve, and you will have one-half of the pattern. By repeating this operation farther along, the entire pattern may be developed.

A Simple Method of Developing the Pattern

Another interesting method of developing this pattern is shown in Fig. 4. It will be seen that the drawing of the top view and the front view is the same as in Fig. 1. The steps taken are: First, draw the top view *U*. Second, divide section *C* into any number of parts, as numbered from 1 to 6. These are swung around to line *W*; then dropped down to the front view circle; then across to section *C*. Third, drop the lines down from section *C*, top view until they cross the same numbered lines running across section *C*, in the bottom view. Mark with crosses and connect with a curved line. This will give the correct front view of section *C*. Now draw the line *X-Y*. Get the correct length by stepping off the distances, as indicated by the same numbers on the circle. Then with the compasses, measure the width of section *C*, front view, line one, and set off the same width on line one of the pattern. Do the same with the other lines and you will have the pattern for one-half of section *C*. After the pattern is developed it is an easy matter to build up the ball, making an almost perfect sphere in the completed ornament.

Sound Advice on Coal Saving

To the man with the shovel

(Prepared in the office of the United States Fuel Administration for the Popular Science Monthly)

WITH trillions of tons of coal in the ground, America is hard-pressed to furnish coal for munitions factories and steel plants; for the Army and Navy; and for domestic consumption.

There are not enough coal cars to transport coal needed for American consumption and for the maintenance of our Allies. If there were enough coal cars, there would not be enough locomotives to draw them. If coal cars could be provided, there would not be enough terminal trackage to handle the enormous increase of freight caused by the war.

The United States Fuel Administration asks that the American people, through measures of conservation in factory and home, fill the gap of fifty million tons which even the increased production of 1917 fails to fill.

Americans have customarily been wasteful of coal. There has always been plenty of coal, at a cost that has seemed very moderate. Why bother to be economical in the use of it? The average man-of-the-house, who manages his own furnace, might be more frugal of his fuel if he realized that every shovelful of coal that he throws into the greedy maw of the ogre in the cellar, represents in money value the price of a loaf of bread or a pint of milk.

From the viewpoint of people fairly well-to-do, the saving of a shovelful here and there has been too petty an affair to be worth considering.

Today, however, we are confronted by a new situation. Now it is everybody's business to save coal. Now coal means munitions and other war supplies. It means transportation. It means the winning of the war.

Yet, if every householder in the United States would save one kitchen shovelful of coal each day in the year, the total saving thereby accomplished in a twelvemonth would amount to 15,000,000 tons.

This quantity would keep 5,000,000 ordinary folks warm all winter. It would keep 7,500,000 soldiers comfortable all winter in cantonments. It would send a fleet of twenty-five battleships across the Atlantic Ocean 3000 times!

If consumers can be aroused to an intelligent consideration of the problem, it is very easily within their power to save, without any discomfort or inconvenience, 10 per cent or more of the coal they have been accustomed to use. They should realize that one man's careless and wasteful use of coal may mean a cold house for his neighbor, and that a few such careless householders may mean an idle factory.

The problem is personal. It deals with the human element. The man whom the Fuel Administration is trying to reach is the man with the shovel. He is the great big factor in the present coal problem. Mainly, upon him, and his willingness to save, must depend the success of the present movement for fuel economy.

In American households there are 15,000,000 coal-shovelers, men and women. When they feed coal to their furnaces and kitchen stoves, they do not realize that it is the very life-blood of the nation that is going into those hungry receptacles. To waste any coal, under present circumstances, is nothing short of criminal.

One-fifth of our total output of coal is used for domestic purposes. Three-fifths are consumed by the railroads and power-plants of the country. Here again comes in the man with the shovel, 250,000 strong.

The Fuel Administration is carrying on an active campaign of technical instruction in the industrial plants of the country. Experienced engineers give instruction in the most economical and efficient firing of furnaces.

As for the householder, he must realize that it is worth while to examine his dwelling and overhaul his heating equipment. Weather-strips, double windows, pipe-coverings, clean flues and chimneys, and tight fittings in furnace parts will all pay. When you save electricity and gas you save coal. Turn out all lights when they are not needed. Use gas sparingly. Clean heating surfaces are most essential.

Soot is even a poorer conductor of heat than is asbestos.

Coal should be used sparingly in open fireplaces. Most of the heat goes up the chimney.

Don't let the house get too warm. It is uncomfortable, bad for health, and it means waste of fuel.

Don't bother with chemical "fuel-savers." They are humbugs.

Keep the rooms below 68 degrees. Most American houses are overheated.

Oil stoves and fireless cookers are recommended by the Fuel Administration as coal-savers.

Let the heat from the kitchen stove remove the chill from the air of the house as long as it will serve.

Reduce the hours of running the kitchen range as much as possible.

Be sure that the smoke-passages in the range are clean. Then keep them clean. If the scraper made for the purpose is lost, get another.

When the range must be run for several hours, a full firebox, carefully controlled by dampers, is more economical than a small fire.

With a big fire, a little air is needed over the coals, as well as through them.

When the fire is carried over night, fill the firebox with coal, cover it over tightly with ashes, and close all dampers. To start the fire, open the dampers below the grate and in the stovepipe. Break up the coke in the firebox, rattling the ashes into the ash-box.

Save as much coal as you can from the ashes, and use it when there is a good fire.

When the fire is well started, close the damper in the smoke-pipe as far as may be practicable with maintenance of the fire needed. When putting in fresh coal, open this damper, to prevent smoking.

Damper control is the secret of economical heating.

By observing these simple rules much coal may be saved. Now for the furnace:

Keep the ashes cleaned from under the grate. The fire will burn more uniformly, and with less clinker, with a clean ash-pit.

It is best to keep a full fire-pot, level with the firing door.

Keep the fire clean of ashes, else it will not be efficient for heating.

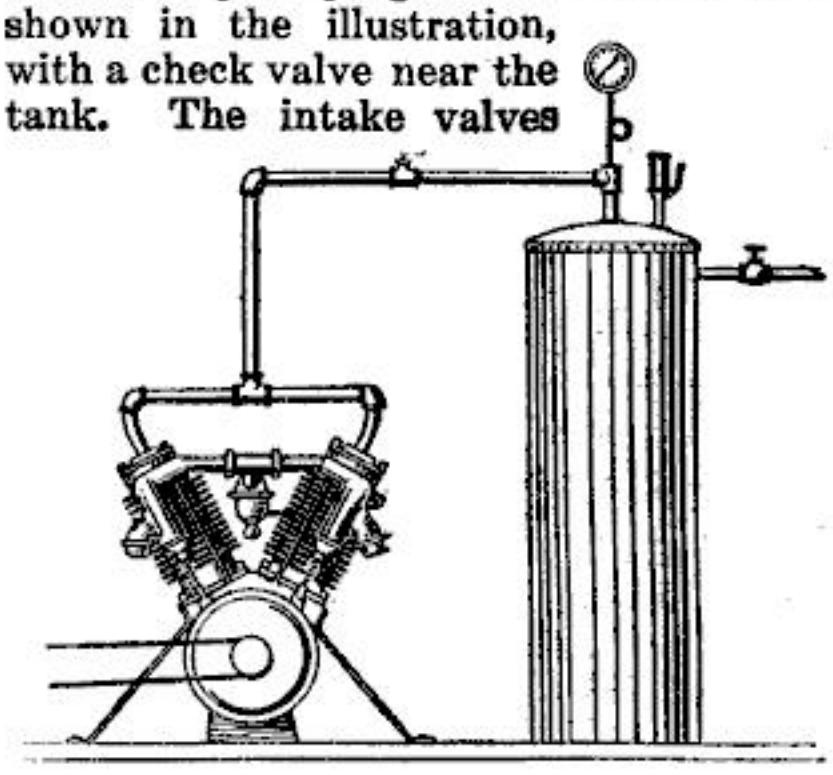
Attend to the furnace regularly. Anticipate the demand for heat. Rapid pushing or retarding of the fire is uneconomical.

Small charges of coal frequently applied are more economical than frequent firing. But the fire-bed should be disturbed as little as possible by shaking or poking. Shaking and clearing the grate twice a day is usually enough.

The United States Fuel Administration and the Bureau of Mines are ready at all times to aid with practical instructions and advice those who are striving to cut their own coal bills and save fuel for the nation.

A Motorcycle Engine used as an Air Pump

A VERY good air pump may be made from an old motorcycle engine of either a single or twin cylinder type. All that is required besides the engine is a few valves, some pipe fittings and a tank strong enough to stand 100 lb. pressure. The exhaust-valve lifts must be removed so that the valves will remain closed all the time, and must be ground in with emery and oil to a good fit to prevent any leaks. The connections are made from the spark-plug holes to the tank as shown in the illustration, with a check valve near the tank. The intake valves



A motorcycle engine mounted on a block of wood. It is used for an air compressor

must be altered, as they work at each stroke of the piston to let in the air. A 30-gal. tank, tested to 200 lb., is used with the safety valve set at 100 lb. The pump will supply a large amount of air if run at 200 r. p. m. and will not heat up to a great extent.—J. W. WOODMAN.

A Block of Wood for Holding the Clothes Line Taut

A CLOTHES line holder that will grip the line tighter as the weight is increased can be made in a few minutes out of two large screweyes, a 2-in. carriage-bolt and a piece of hard wood about 6 in. long, 2 in. wide and ¾ in. thick, cut as shown.

Cam-shaped block to hold clothes line

First, drill a hole that the carriage-bolt will easily pass through in one corner, about 1 in. from the end and ½ in. from the side. Now round off the corners to the shape shown in the sketch. Next, screw the screweyes into the clothes-post far enough apart so that the wooden block will easily pass between them, as shown. They should be screwed in until the centers of the eyes are about 1½ in. from the post. Then place the wooden block between them. Line up the hole with the screweyes and insert the bolt.

To use the holder, lift the end and drop the clothes line in the space between the screweyes. Pull down the end again and it will wedge itself against the clothes line with a grip that will tighten as the load grows.—FRANK L. MATTER.

Making a Barometer from a Burned-Out Electric Globe

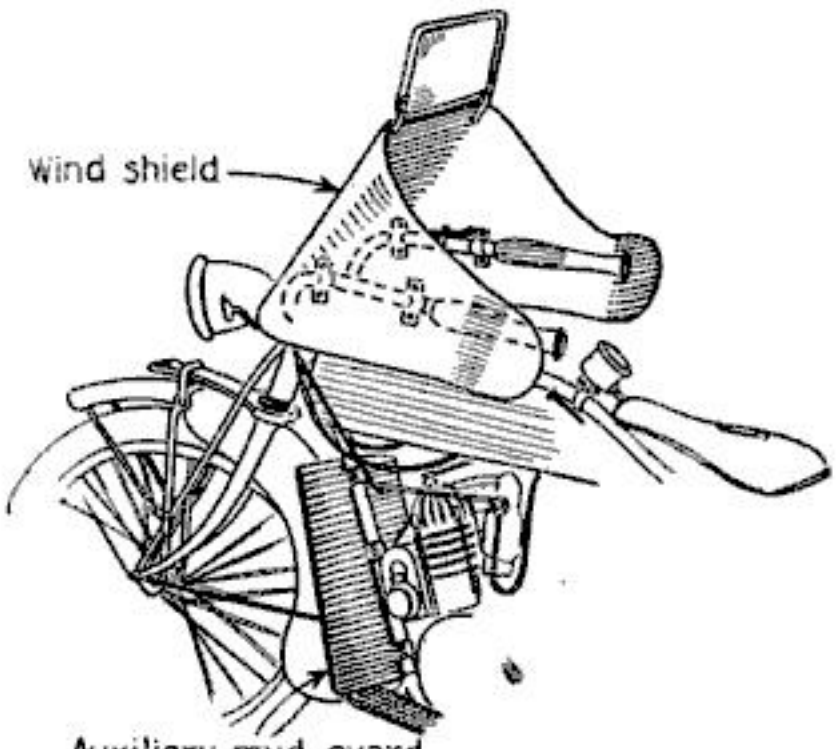
A BAROMETER, which will prophesy weather conditions a day in advance, may be made from an ordinary incandescent bulb. Select a 60-watt lamp. One that has burned out will do. Hold it under water and file off the glass tip at the end of the bulb. The vacuum will cause the water to enter through the hole thus made, filling the bulb completely. The barometer should then be suspended with bulb end downward.

When a drop of water appears suspended at the outlet, you may look for a storm to-morrow; when the drop disappears, fair weather is in store. There is a perfectly natural reason for this phenomenon. Stormy weather is always preceded by low barometric pressure. The atmospheric pressure having decreased, the weight of the water inside the bulb tends to force water through the outlet. This force is small, but it is sufficient to allow a drop of water to escape and hang suspended from the tip of the bulb. On the other hand, fair weather follows an area of high barometric pressure. The pressure of the atmosphere, under such conditions, will prevent the water from escaping and the suspended drop will be forced back into the bulb.

This simple barometer may be screwed into a wall or ceiling lighting fixture, which is out of service.—K. M. COGGESHALL.

How to Make a Windshield for the Motorcycle Messenger

THIS windshield is made of sheet metal bent to conform to the shape of the handlebar. As shown, three fastenings are used, but more may be applied if desired. One is at the head and the other two are about half way between the grips and the head. It is topped with an isinglass protector, fastened as illustrated. There is a flare of each grip to make room for the hands, and to shelter them from the wind and rain.



Sheet metal, shaped and attached to the handlebars to serve as a wind shield

The mudguard is also made of sheet metal. It consists of two wings bolted to the frame so that the front guard will clear, the footboards having just room to fold up.—GEO. STENCHAM.

How to Make a Strong Glue That Will Withstand Moisture

A GLUE that is waterproof, is very useful to have around the house for various repair jobs, as well as for new work in the amateur experimenter's shop. Waterproof glue is superior to the ordinary kind, as it resists dampness and is richer in adhesive properties. The formula is as follows: Soak ordinary glue in water until it swells up, but does not lose its shape. When it is thus softened, drain the superfluous water from it and transfer it to a glue pot. Add an equal quantity of linseed oil and boil the mixture over a slow fire until a jelly-like mass results. It is then ready for use. Such glue will join various materials in the most satisfactory manner. It holds remarkably well, dries quickly and resists moisture. It can be depended upon in every respect.

Another Card Trick—the Inseparable Jacks and King

THE feature of this trick is that three jacks and a king are withdrawn from the pack which is shuffled. Then the four cards are placed in various parts of the pack and the pack is cut. When examined it will be found that the three jacks and the king have rejoined one another and are now all together in the center of the pack.

Begin by taking out the three jacks and one king, and, while looking over the pack for these cards, contrive to slip the fourth jack to the bottom of the pack. Give a false shuffle, leaving the fourth jack at the bottom of the pack. Now, proceed to place the four cards in various parts of the pack as follows: Place one of the jacks at the bottom of the pack, one at the top, and one in the center at any point. Place the king on top of the pack. By this arrangement of the cards there will be two jacks on the bottom of the pack and one king and a jack on the top. It is obvious that if the pack is cut, all four of the cards, the three jacks and the king, will be brought together in the center of the pack.

The jacks finally shown are not the ones originally selected, the one placed in the center of the pack is lost, and its place taken by the jack secretly placed at the bottom of the pack prior to the commencement of the trick. It is very seldom that this fact is noticed by the audience.

Making Simple Life Slides for Microscopic Work

THE practical pond microscopist quickly discovers that the glittering brass and glass paraphernalia supplied by the optician are not only unnecessarily expensive but often by no means well adapted to his requirements. The several devices herein described can be made easily and will be found to serve a variety of purposes.

For low power work, where an objective that will work through an ordinary 3 by 1-in. slip is used, the slip described herewith,

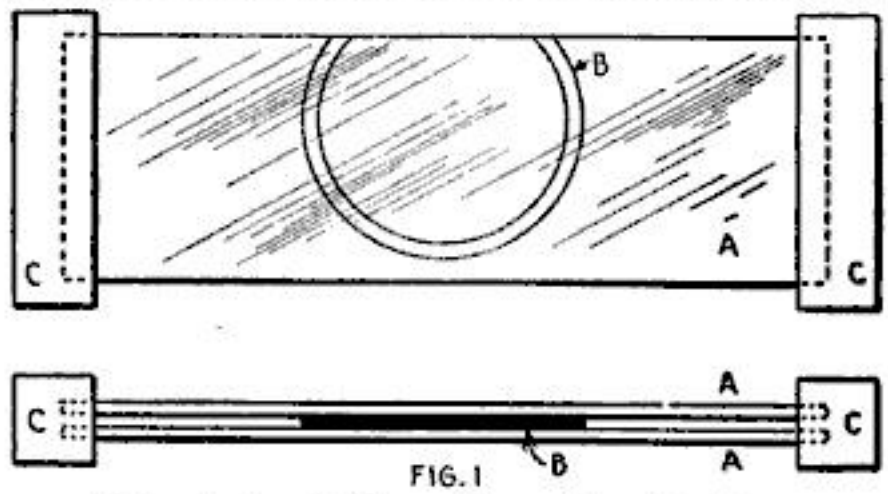


FIG. 1

Two strips of glass with rubber ring between, held together with wooden pieces

will be helpful. Two 3 by 1-in. glass strips are used, shown at *A* in Fig. 1. Inclosed between them is a rubber ring *B* from which a piece has been snipped with a pair of scissors. A piece of hard wood *C* is slipped over each end. In this, a groove is cut the requisite width to hold the glass pieces together. Put just sufficient pressure on the rubber to prevent leakage of water. Two or three such slides can be made, using rings of different thicknesses.

An exceedingly simple life chamber, but one that is useful for many purposes, is made

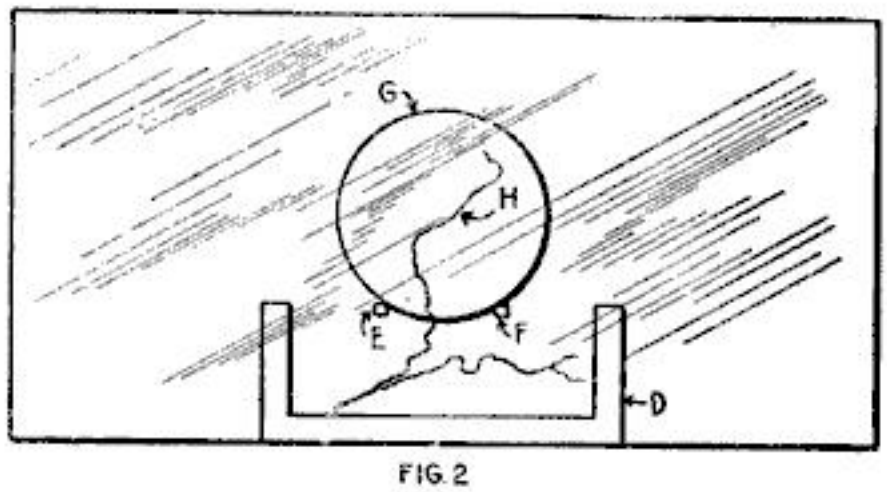


FIG. 2

A reservoir slide to hold nutritive fluid that is convenient for examining algae

by turning a ring of paraffin wax on the object slide; covering it with a thin glass. Two or three very small threads should be

placed in the center of the ring. The object of the threads is to prevent the drop of water running around the sides of the cell.

A reservoir slide, Fig. 2, is sometimes convenient, particularly for the examination of algae, as it provides a relatively large volume of nutritive fluid. A useful trough can be made on a 3 by 1½-in. slip in the following manner: Cut a piece of flat and parallel-sided hard rubber to the shape shown at *D*, so as to make a trough about 1¼ by ½ by ¼-in., and cement this to the slip midway between the ends and flush with the sides. Cover this with an oblong cover glass or a piece cut from an object slide, cemented on water tight. Two small pieces of glass, *E* and *F*, should be cemented to the slip to form ledges on which a circular cover glass, *G*, can rest without risk of its slipping down into the trough. A filament of growing algae, *H*, is shown ready for examination, having been passed up from the trough in which it was growing, and covered with the thin cover glass.

In Fig. 3 is shown another useful though very simple device. It consists merely of a 3 by 1-in. slip, around which two pieces of silk or cotton threads, *I* and *J*, are tied a short distance apart, the covered glass, *K*, being laid across them. This forms a shallow cell which is open to the air almost all around. The water can be renewed as it evaporates by adding a drop to the edge

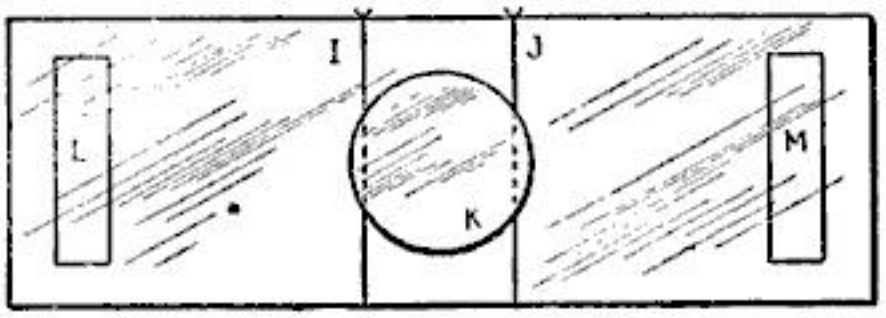


FIG.3

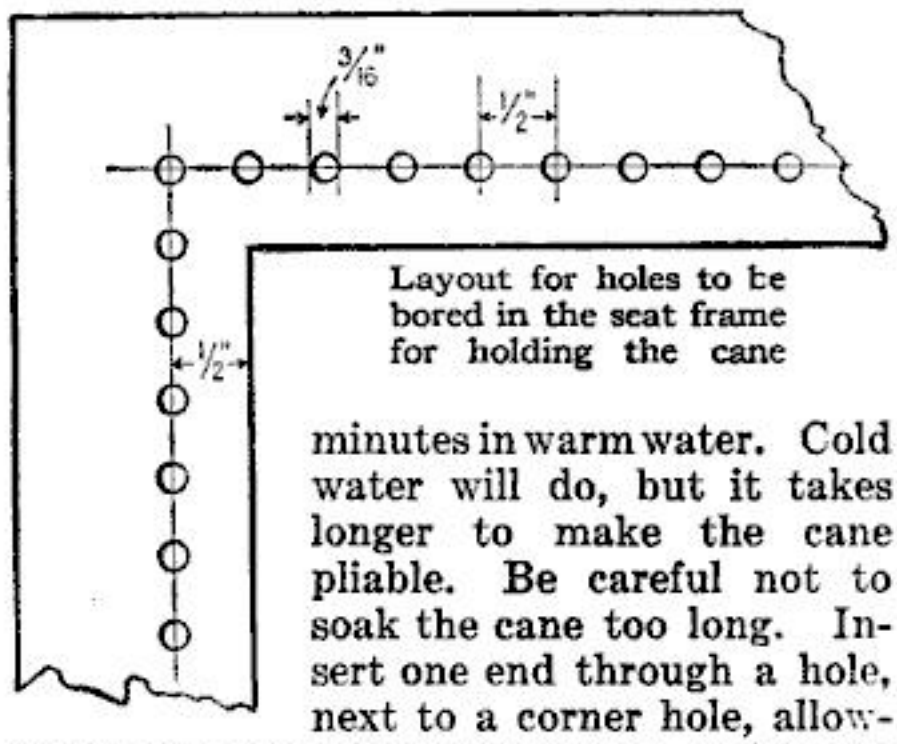
A slide that provides a way to renew the water by adding a drop to the edge

without disturbing either the object or the glass. The drop will be sucked up by capillary attraction. Areation of the water is thus facilitated.

In order to make the slide rest firmly on the stage, stick small pieces of paper, *L* and *M*, to the underside, one at each end. Several slips may be prepared, using different thicknesses of thread. These may be numbered in accordance with the depth of the cell. The numbers should be written on one of the paper strips so that they may be read through the glass.—H. J. GRAY.

Cane Chair Seats and How to Weave Them

THERE are seven steps in the weaving of the cane for a chair bottom, or other paneled work. These are described and illustrated in a new book, entitled *Seat Weaving*, by L. Day Perry (Manual Arts Press). First of all, the cane must be soaked for a few



Layout for holes to be bored in the seat frame for holding the cane

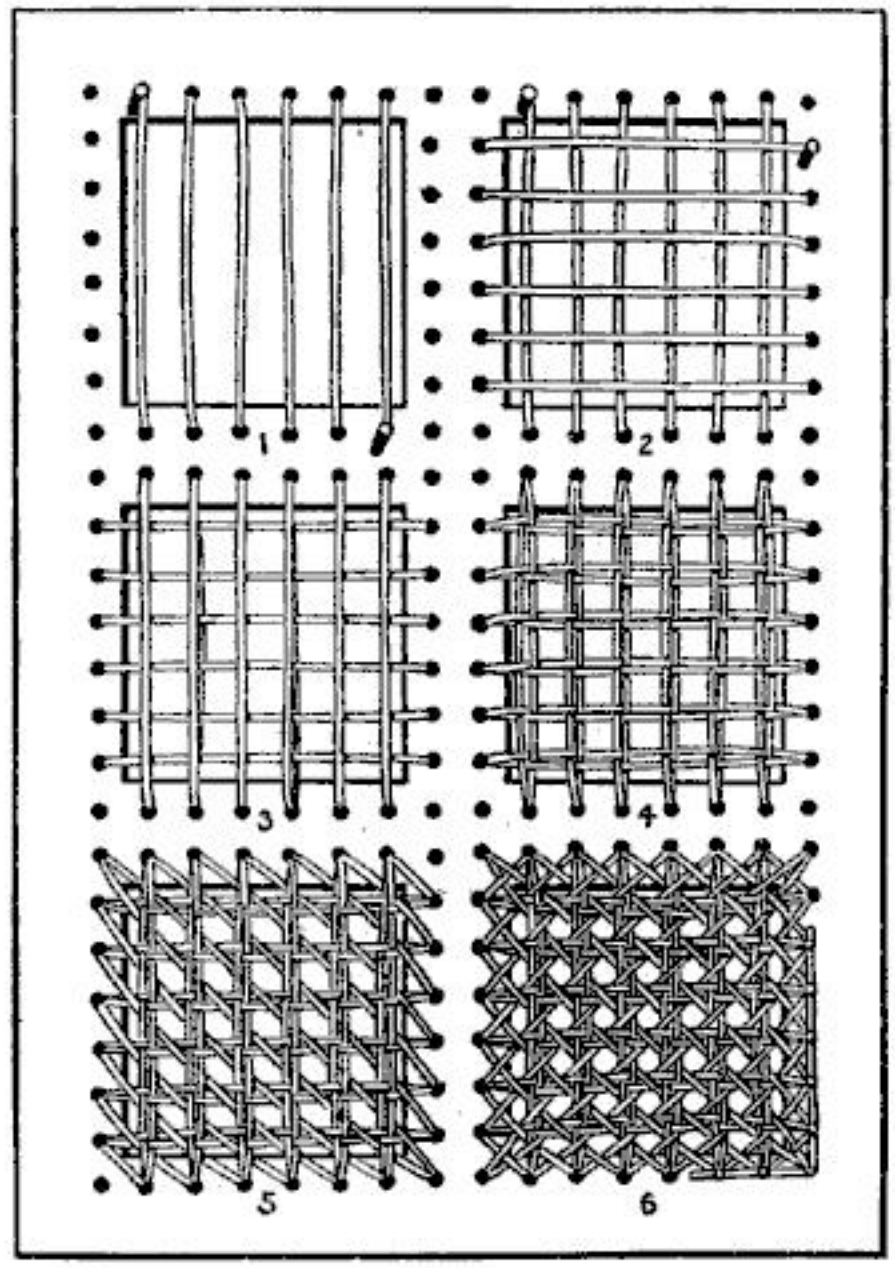
minutes in warm water. Cold water will do, but it takes longer to make the cane pliable. Be careful not to soak the cane too long. Insert one end through a hole, next to a corner hole, allowing it to project about 3 in. below, and fasten it by driving a peg in the remaining part of the hole. Pull the entire strand through between the thumb and forefinger to prevent its twisting, and run the other end down through the opposite hole, next to the corner hole. Make sure that the smooth side of the cane is out on the underside of the frame as well as on top. In doing this, the cane is pulled reasonably taut, then fastened in the latter hole with a peg to prevent its slipping back and becoming loose. Draw the cane through between the thumb and forefinger again, pull it over to the next hole, or second one from the corner, and run the end up through and across the top, parallel to the first strand, and down through the opposite hole in the other piece, or second hole from the corner, and fasten with a peg. This operation is repeated until all holes have been utilized on the two parallel rails, except those at the corners. Throughout the seven operations, the cane must be kept from twisting by drawing it between the thumb and forefinger. With this first step completed, all holes in the two rails opposite will be entered, with all cane running parallel and on the upper side, the cane crossing from hole to hole on the underside.

The second step is just the same as the first; the only difference is that the other two rails of the frame are used and that the

cane runs over the first set of parallel cane. If the first strand of cane has not been used up in the operation, the remainder is used to begin the second step.

The third step is a repetition of the first two. The cane of the series runs over the first and second series and parallel with the first. As each strand is used up, bind the end by pulling it under a cane, crossing from one hole to another underneath the frame. Then cut it off about ¼ in. from the cane. This binding is clearly illustrated. The loose end at the starting point is tied in the same manner, and all other ends should be tied as soon as the strand is used up. Thus the use of many pegs is avoided and a neat binding is assured.

The actual weaving begins with the fourth step. This may be done entirely by hand, but it is slow work. A needle should be used. Start at a hole next to a corner one on either rail that has been used but once, working from the caned side toward the open frame. Pass over and and under the strands necessary to form the weave, turning the needle from side to side in order to catch the canes back of the point. When across, thread the needle with the strand and pull it through, being careful to avoid a twist. Pull the end down through the hole, pairing the canes. Pull the cane up through the next hole and start the needle from the opposite side of the frame. Repeat the first operation, thus pairing another set of canes. Continue this operation until all the canes are paired and all holes used. Soak the woven cane with a wet sponge, and with two pegs straighten the strands of cane and force all pairs together. Small open pairs are thus formed over the area being caned. Unless the cane is soaked very thoroughly, it will prove rather difficult to pair the canes.



Successive steps in placing the cane in the holes for making a bottom in a chair

The fifth step is the weaving of one set of diagonals. Start the strand at any corner hole. Use one hand over and one under the frame. As the worker becomes more skillful, he find it easier to give the cane a slight curve and work with both hands on the upper surface. Use an end of cane long enough for convenient handling, then pull the entire strand through the length of the frame, provided the area is not too great. Care must be taken to avoid twisting the cane. The cane runs very easily and partially under a cane at the corners of the squares, if the weaving is correctly done. This is plainly shown in the illustration. All the corners bind and the strand pulls with great difficulty if the cane is incorrectly woven. On parallel canes see that the canes run either over or under the pairs.

The sixth step is just the same as the fifth, the canes running at right angles to the first diagonals. In this step and the preceding one, note that two strands run into the corner holes. This holds true in all rectangular frames where a corner hole is bored. It permits the strands to run in as straight a line as possible. If it is necessary to turn abruptly to enter a hole it is obvious that an error has been made by the weaver.

In the seventh step a cane of the same size as that used for all the work is pulled up through a hole, over the binder-cane and down through the same hole. A loop is thus formed and the binder secured. Pull taut, then enter the next hole, pull up the cane over the binder, then down, and so on. This operation may be repeated at every other hole, when the holes are close together. The two ends of the binder are finally overlapped and carefully secured.

A RIFLE RANGE

By Geo. M. Petersen

IN these times, when efficiency for military service is the principal requirement of men, it is well for everyone to understand thoroughly the handling of firearms and how to use them most effectively. Not only is such knowledge a protection, but the Government gives increased pay to those men who can qualify as sharpshooters or experts.

Of course there are numerous exercises which may be practiced to good advantage, but there is nothing which will perfect your shooting like real firing on a range.

Even as a mere pastime, shooting is beneficial, as it trains the eye, the hand and the entire nervous system so that they may be kept under absolute control. A rifle range can be laid out and built anywhere where there is space enough to get the different ranges or positions desired and to care for the bullets after they pass through the target.

The most common methods of constructing the pits or "butts," as they are termed, are shown in Fig. 1 and Fig. 2, the latter type being the most generally used. The type shown in Fig. 3 is for pistol and small-caliber rifles only, and should never be used for high-power sporting or military rifle work as there is a possibility of the bullets passing through the wooden retaining wall and injuring someone.

The best ground for a rifle range is smooth and level or it has only a moderate slope. The targets should preferably be on the same level as the firer or slightly above him. Firing downhill should be avoided. The light should also be considered when laying out a range. If possible, the firing should be toward the north or slightly east of north so that a good light will be on the targets during the greater part of the day. Security and suitable ground are much more important than direction of light, however, so that naturally they must be considered first.

As high-power sporting and army rifles have a range of from two to three miles, it is imperative that an effective bullet stop be provided behind the targets to prevent the bullets passing through the targets and killing or injuring someone in the far distance. Where the butts are situated on the bank of a large body of water, so that the bullets will drop into the water without doing any harm on the way, it is only necessary to have a lookout stationed at one side of the butts and high enough so that he may observe the entire field of fire with the aid of

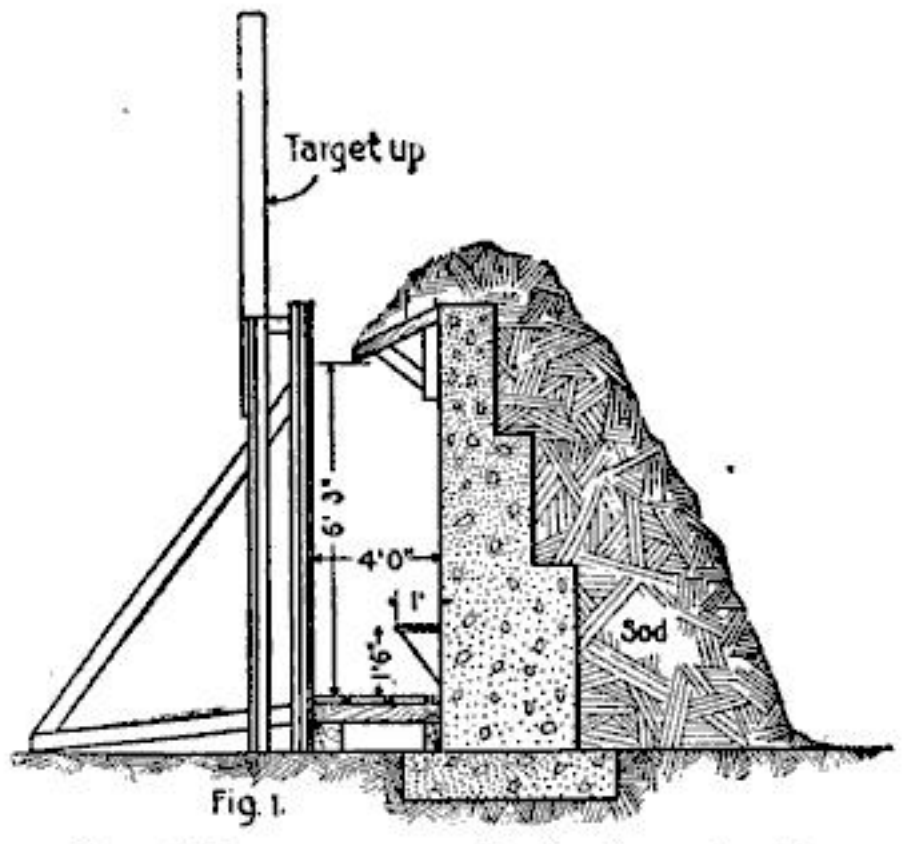
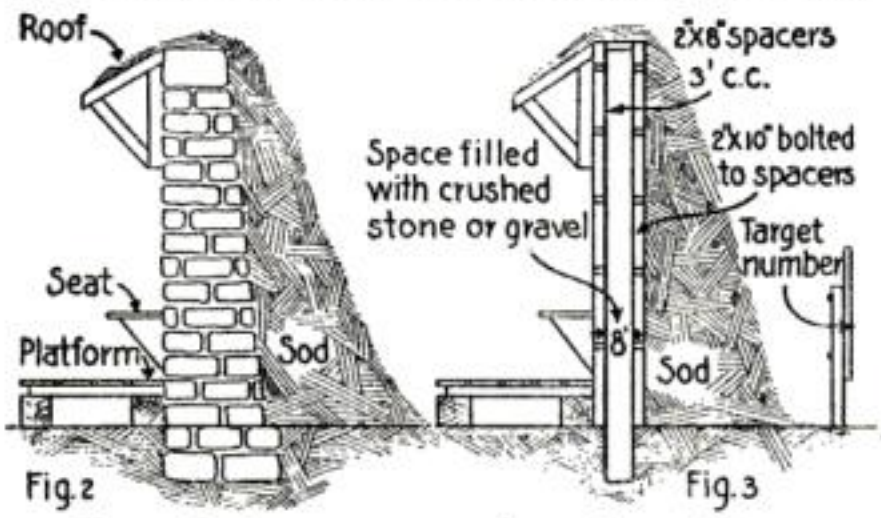


Fig. 1.

One of the common methods of constructing a pit or butt, behind which is the target

field glasses. This lookout is responsible for stopping the firing when a boat is passing within range of the rifle fire. He accomplishes this by lowering a large red flag to half mast. As soon as the person in charge

of the butts sees the flag go down, he immediately orders his target half masted and the red flags placed on each one until the lookout runs his big flag up to the top of the mast, signifying that the coast is clear. However, when this method cannot be used,



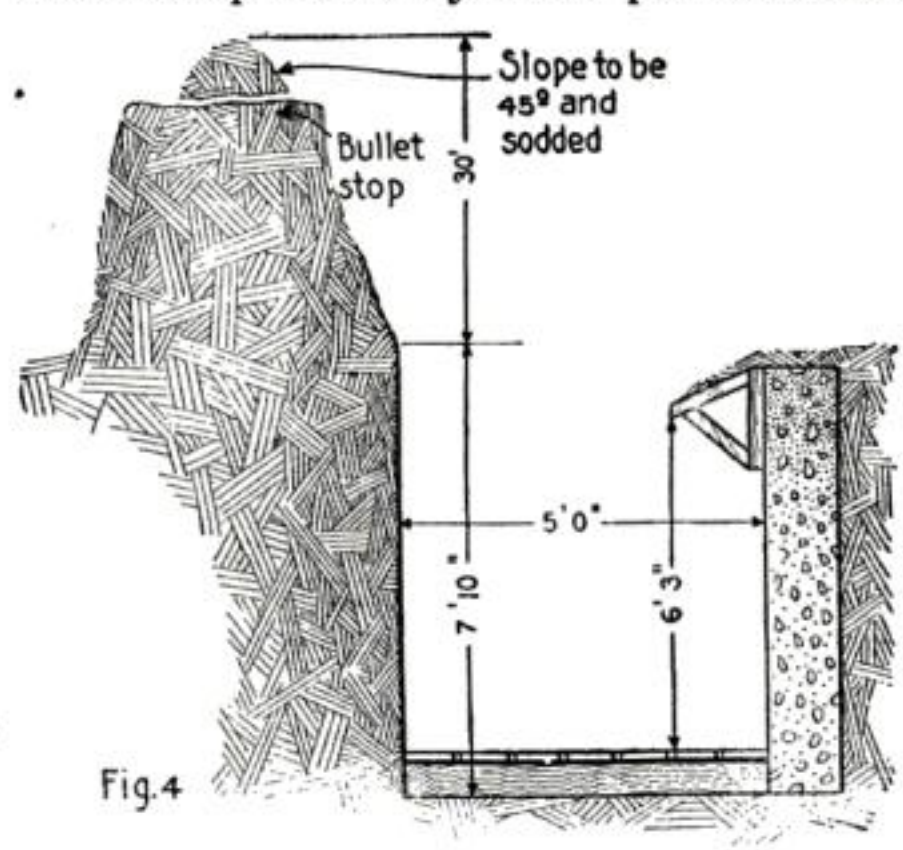
Cne of the most popular pits. Also a target pit for pistol or small caliber rifles

a bullet stop, similar to the one shown in Fig. 3, should be built.

This stop should be about 30 ft. in height, with a slope of about 45 deg. and should be built up of earth, logs, wood and similar soft materials which will not cause the bullets to ricochet. The face of the stop should be covered with sod and it should be free from stones. A natural hill can sometimes be used for this purpose, by cutting steps into its face and grading the space between these steps to the 45 deg. When a natural hill is used as a stop, the pit may be sunk down so that the appearance of the completed butts is similar to that shown in Fig. 4. In any event, the bullet stop should extend from five to ten yards beyond the last target at either end of the butts.

In Fig. 1 we have a concrete retaining wall over which the earth is piled, tamped and covered with sod. This type is desirable where stone is scarce or transportation difficult, although the stone wall shown in Fig. 2 seems to be the most popular, when the material can be readily obtained. As mentioned before, the wall shown in Fig. 3 is used only for pistol or small-caliber rifle work, as it would hardly afford protection enough against bullets fired from a high powered army or sporting rifle. In this type of wall, 2 by 8-in. planks are stood on end, 3 to 4 ft. from center to center, and 2-inch planks are bolted to them on each edge. This leaves an air space between the two walls which may be filled with crushed stone or coarse gravel. The earth should be piled at least 2 ft. deep over this type of wall so as to remove any chance of a bullet ploughing through it, even though someone should inadvertently fire a high power bullet into it. The cost of this type of wall would nearly equal that of concrete wall so it will be seen that it would be foolish to use this wooden wall except when the cost of transporting cement, gravel or stone would be much above normal. In Fig. 4 is shown the submerged type of pit. When drainage facilities are available, this is a good type, although a pit which is half way between Fig. 2 and Fig. 4, that is, a pit which is half excavated and half built up, is, to my mind, the best and most satisfactory as well as the cheapest in the long run.

In Fig. 5 is shown the details of the roof construction. This roof is covered with earth and sod. It is not absolutely necessary to cover the boards, as the only duty devolving upon them is to prevent the dust, dirt and small stones from falling on the men in the pits when a low shot knocks the top off the parapet. The sod does improve the appearance, however, and for that reason it is generally used on club ranges. In Fig. 6 is shown the platform construction, which consists merely of 4 by 6-in. sleepers, on which are placed 2 by 10-in. planks about

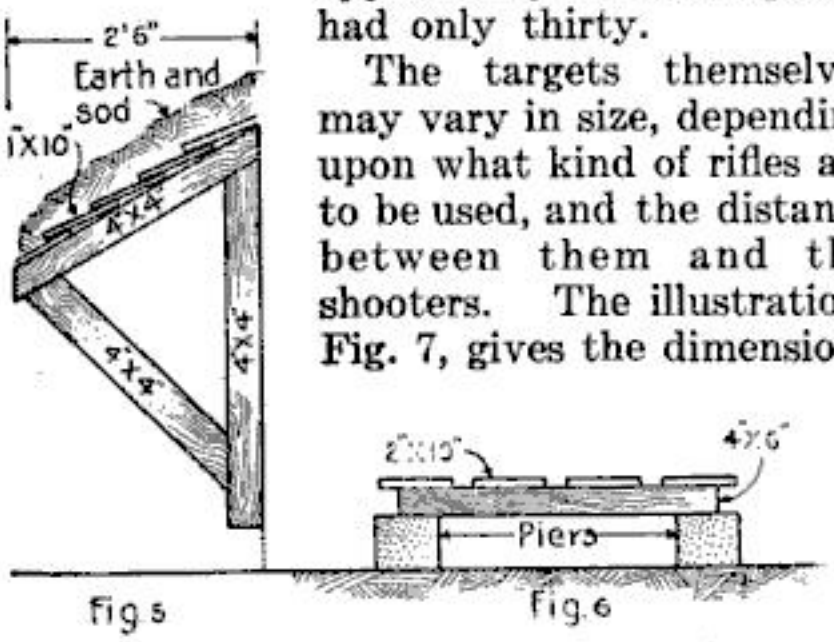


Where a natural hill is used for a stop, a pit for the signal man is dug in front

3 in. apart. These platforms should be placed well above the bottom of the pit so that the sun and wind may get underneath them and keep the bottom of the pit dry and sweet.

The length of the butts are naturally, governed by the number of targets it is de-

sired to mount, each full-sized target requiring about 10 ft. of space—7 ft. for the target and 3 ft. for a walk between the targets, to make it easy to handle the rear targets. A range may have from one to sixty targets, although the largest one I ever had the opportunity of shooting over had only thirty.



Details of the roof. Also platform for the men who are watching the target to stand on

The targets themselves may vary in size, depending upon what kind of rifles are to be used, and the distance between them and the shooters. The illustration, Fig. 7, gives the dimensions of the army targets for various ranges and kinds of fire. These dimensions may be used as a basis upon which to determine the size target most desirable for the particular work in hand. A pistol target is shown in Fig. 8.

The "standards" for the targets are made as shown in Fig. 9, the rear end being weighted down by putting a plank across the two braces and loading it down with stones or other heavy materials to help keep it rigid and straight. The "carriers" for the targets are shown in Fig. 10, two carriers and two targets being provided for each standard, the targets so counterbalancing each other as to greatly facilitate handling and working.

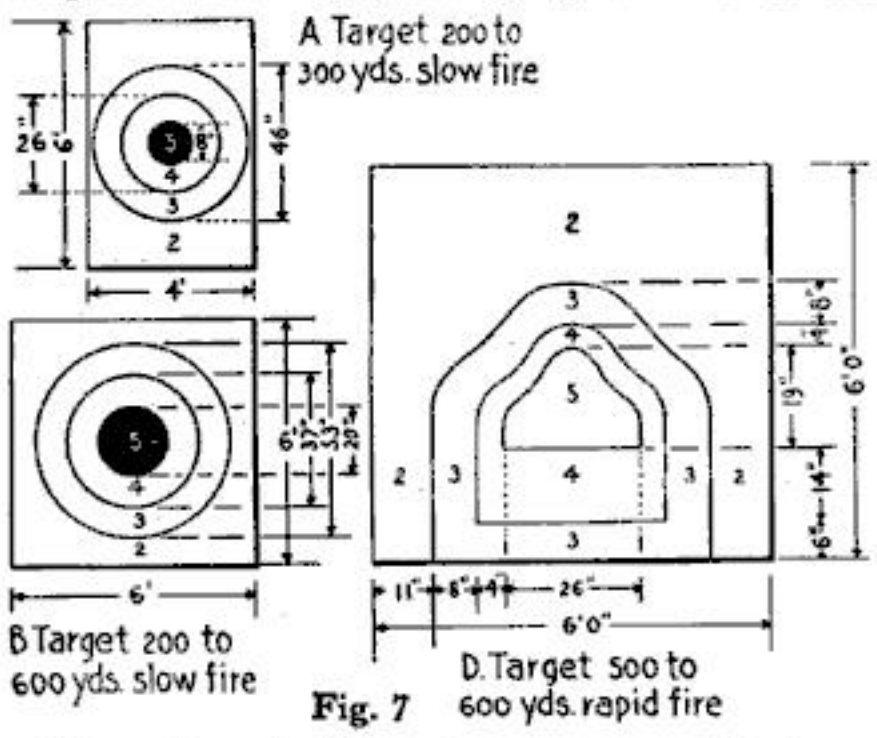
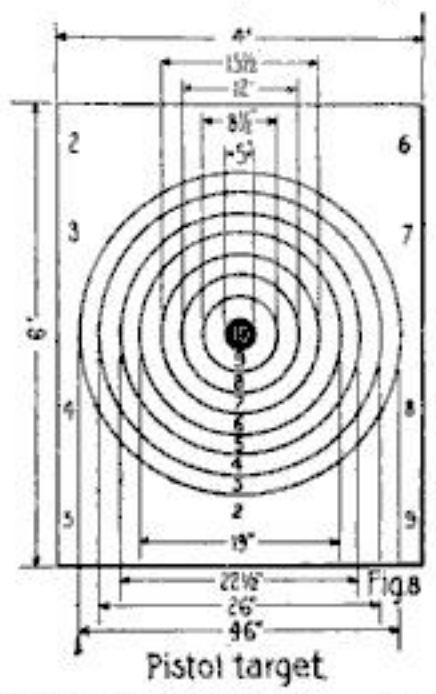


Fig. 7

Sizes of targets for various ranges and kinds of fire which may be used as a base

Target frames are made as shown in Fig. 11, the space marked "A" being covered with light-weight canvas or heavy unbleached cotton. On these the paper targets are pasted. The complete "target" consists of one standard, two carriers and two target frames as shown in the assembled drawing in Fig. 12, the targets in the drawing being half masted, *i. e.*, one behind the other.

In Fig. 13 is shown the marking disks. These disks are secured to long poles, one disk at each end, each side of each disk being marked differently. For example: For a shot in the center of the target, commonly called a "bulls-eye," the white disk, having a value of 5, is shown. If the shot was in the 4 ring, the red disk is shown ; the 3 ring requires a black and white disk, and a shot in the 2 ring calls for a black disk. A "miss" is recorded by slowly moving a red flag across the face of the target, while a ricochet hit (one which hits the target after striking some other object) is shown by moving the ricochet flag up and down in the center of the target.



Dimensions for a target to be used for pistol practice

When a shot is "called," it is given its value and its "o'clock," the target being considered a clock laid out as shown in Fig. 14. The first shot recorded is called an "eleven o'clock three" or "a three at eleven o'clock." This indicates to the firer that he is shooting high and to the left of the bull. The second shot shown is a "four at six o'clock" which means a correct alinement, but a little low. The third shot is a "two at one o'clock" showing that the aim was to the right. After a little practice the "o'clock" becomes natural to you and you think of all of your shots in this manner.

After each shot is fired, when firing the slow fire course, the targets are pulled down, the hole pasted up, the target run up and the shot marked by means of the code given above, care being exercised to get the right side of the marking disks out. By locating the shots correctly on the target, the firer can

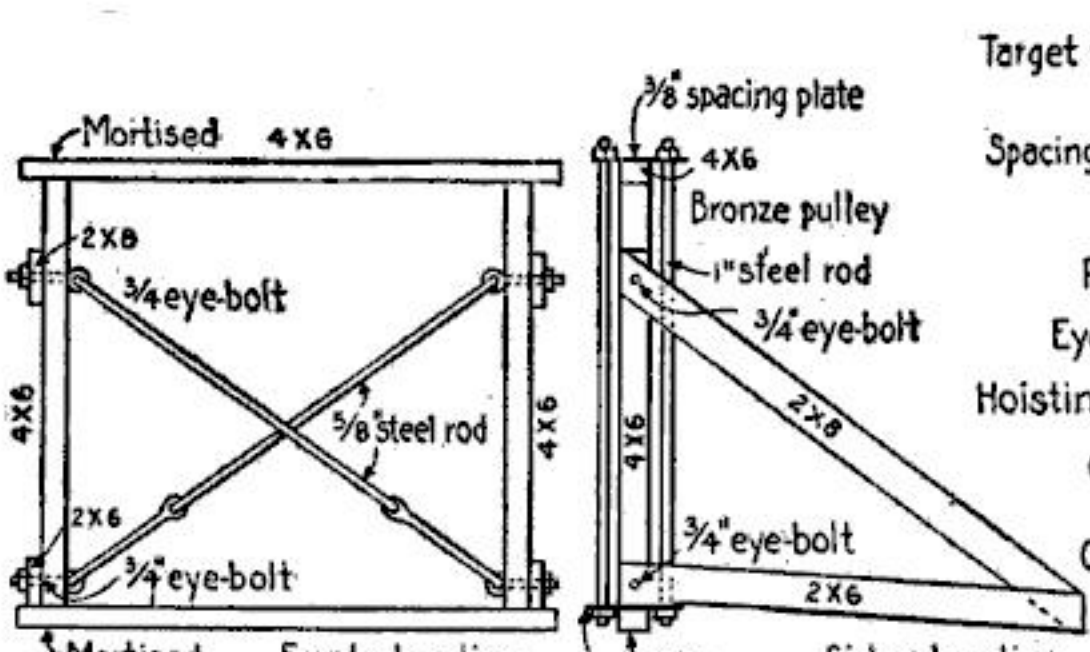
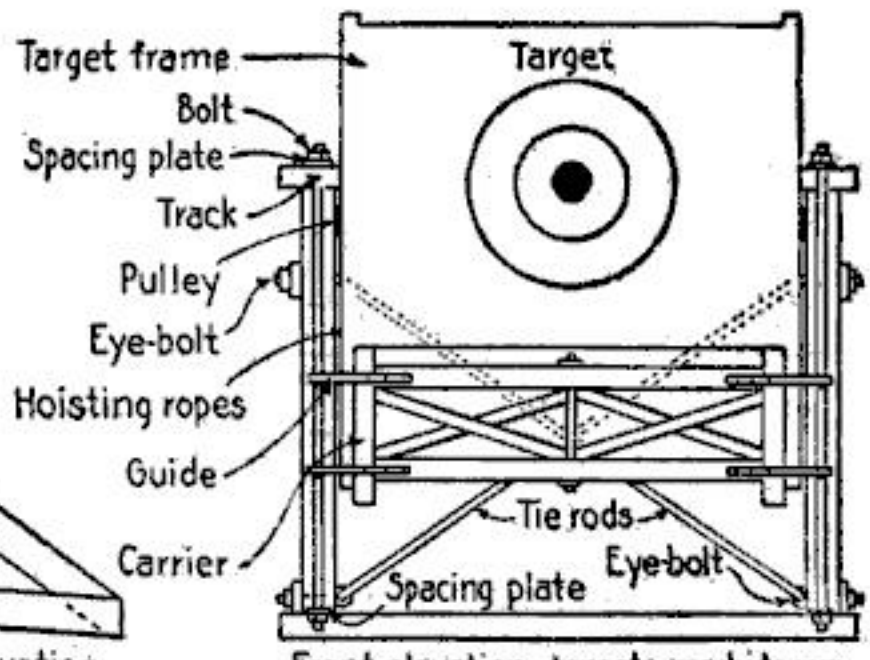
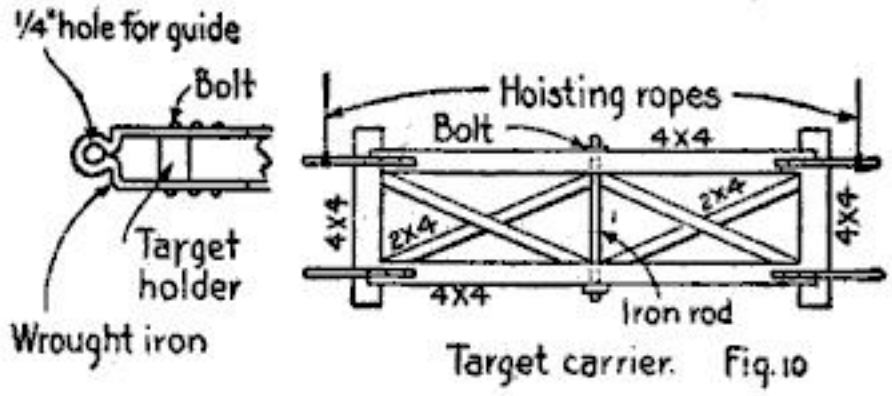


Fig. 9



Front elevation—targets ready to run

Fig. 12



Target carrier. Fig. 10

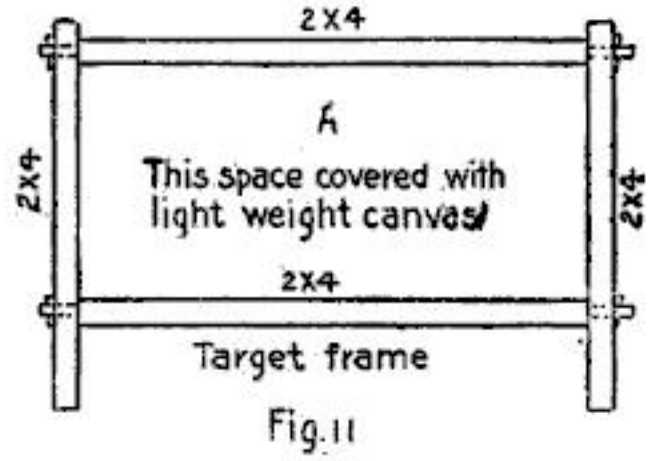


Fig. 11

Framework or standard for two carriers and two targets, one counterbalancing the other. The targets are pasted on a canvas stretched over the sliding frames

eventually get the zero of his rifle, or learn just where he must hold his pistol in order to do good shooting.

Pistol targets are marked differently than rifle targets because of the different rings and values on the target. Only the red and white disks are used, the white for the bull or

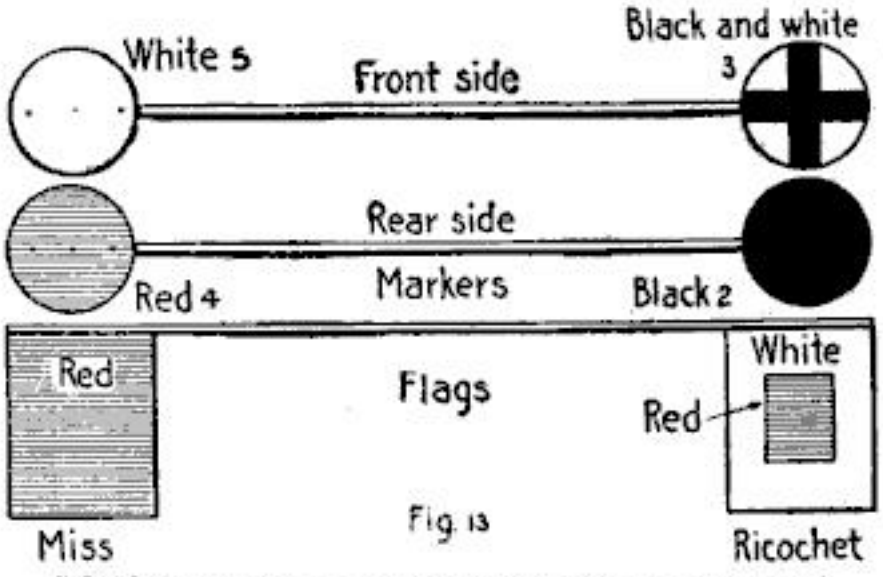


Fig. 13

Marking disks, mounted on poles, to signal the contestant the location of the shot

10's and the red for all others. The red disk is first placed over the shot hole and then moved over until it blocks out the large number on the edge of the target which represents the value of the shot. For instance, if a shot was through the seven ring, the red disk would first be placed over the shot hole and then moved over until it covered the seven on the side of the target.

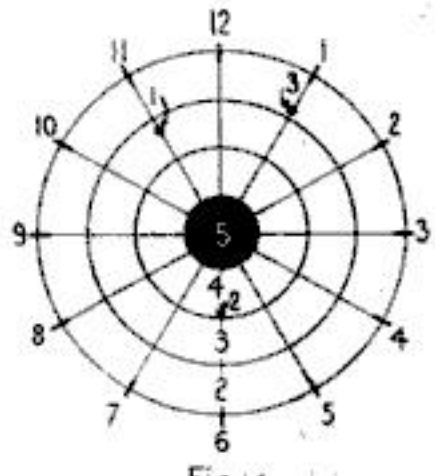


Fig. 14

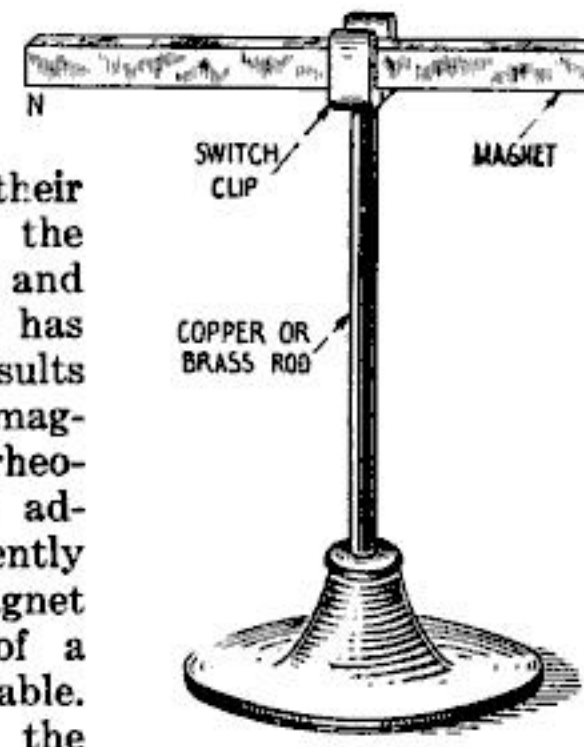
With the aid of the information given herein, it should be possible for every little club or town to have a rifle range where the men and women, and boys and girls may have an opportunity to learn to use firearms in the proper way, so that they will become a blessing in an emergency. A thorough knowledge of firearms would also decrease the number of accidents with them, most of which are due to lack of understanding. With a little practice in using a firearm, the most timid need not be afraid to use one in cases of emergency, and will in many instances grow to enjoy target shooting for its own sake.

The Amateur Electrician

And Wireless Operator

Use of a Permanent Magnet with the Audion

MANY articles have been published in electrical publications regarding the use of permanent magnets in connection with vacuum tube detectors. Some authors state that the intensity of signals is greatly increased, by the use of magnets, while others find that no advantage is gained by their use. Experiments with the various types of magnets and several makes of tubes, has shown that while good results may be had without the magnet, providing a filament rheostat with a very delicate adjustment is used and patiently adjusted, the permanent magnet is an accessory worthy of a place upon the operating table. Because the output of the filament battery varies gradually, especially if a small storage battery is used, readjustment of the rheostat is necessary from time to time. The best adjustment of some tubes is so critical that it can seldom be reached with the standard battery rheostat.



Convenient stand to support magnet in various positions

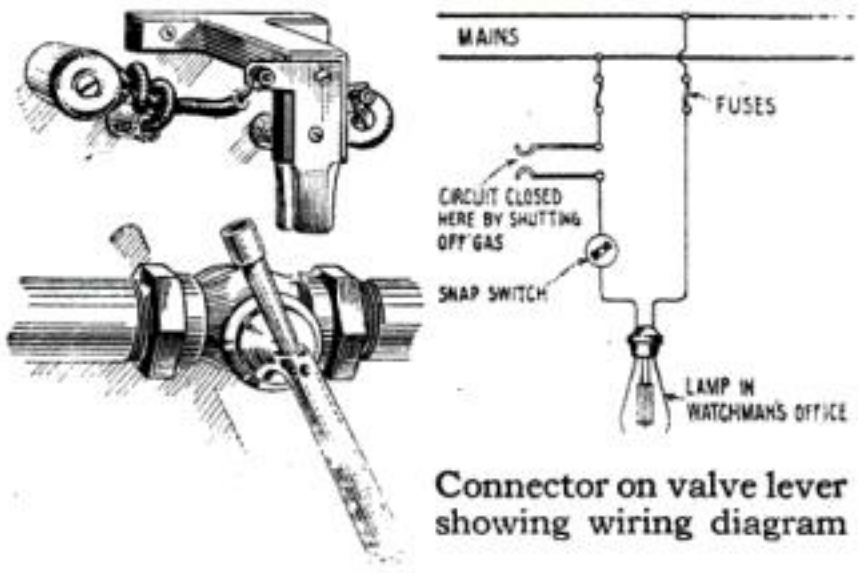
If the rheostat adjustment is left slightly below the critical best point and a permanent magnet (a bar magnet is best) upon a suitable stand is moved toward the tube, the electron discharge will be varied by the influence of the magnetism, and a point will be reached where the signal intensity of certain stations is loudest. A further movement of the magnet toward the tube will cause a reduction in signal intensity, and sometimes the rheostat adjustment may be such that a second position of stronger intensity may be found with the magnet very close to the tube. The position of the magnet in the second field must be more precise than in the first field. It seldom permits more than 1/16 in. variation. The polarity of the magnet will also be found to make a difference, one pole bringing in louder signals than the other pole, regardless of their positions. Interference may often be reduced by the use of the magnet in the first sensitive field, and the adjustment is far better than that secured by the finest manipulation of the receiving instruments. A slight movement of the magnet within this field will generally cause one of two stations, having about the same signal intensity, to fade, thus making the other readable. An adjustment of the magnet in the opposite direction may cause the other station to fade and make tne first readable.

The magnet seems to have a different effect upon some stations, which though quite loud and readable with the magnet in one of the fields, will come in still more strongly when the magnet is withdrawn from the tube.

A convenient stand for supporting the bar magnet in various positions is shown in the illustration. The base of the instrument should be cast and turned out of babbitt metal, and may be nickel or silver plated. A hole is drilled and tapped to receive the threaded end of a brass or copper rod, of a length depending upon the height of the detector from the table. A switch-blade clip removed from an old switch, or its equivalent made from spring brass, is soldered to the upper end of the rod and is used to hold a small permanent bar magnet as shown.—H. W. OFFINS.

Signal Light to Show Gas Turned Off at Oven

A SMALL manufacturing concern which uses a gas heated enameling oven, found that considerable gas was wasted because the workmen frequently forgot



Connector on valve lever showing wiring diagram

to shut off the gas when quitting their work for the night. As a result, the oven burner would be left on all night, with the consequent waste of gas and the liability of overheating and setting fire to the building or of doing damage to the oven and its contents.

To prevent this, the shut off valve on the gas line was provided with an insulated extension on the valve handle, as shown in the illustration. Over the end of this insulated extension is placed a metal ferrule which closes the contact between the two metal contact pieces attached to the two wires when the gas is shut off. These two wires form one side of the circuit for the lamp located in the night watchman's office, so that the gas must be shut off before the lamp can be lit. Should the gas be left turned on after working hours, the watchman is aware of the fact as soon as he comes on duty, as he can only secure light in his office when the gas is shut off from the oven burner. The diagram in the illustration shows the wiring scheme in which a snap switch is used to turn off light after the signal shows that the valve has been closed.

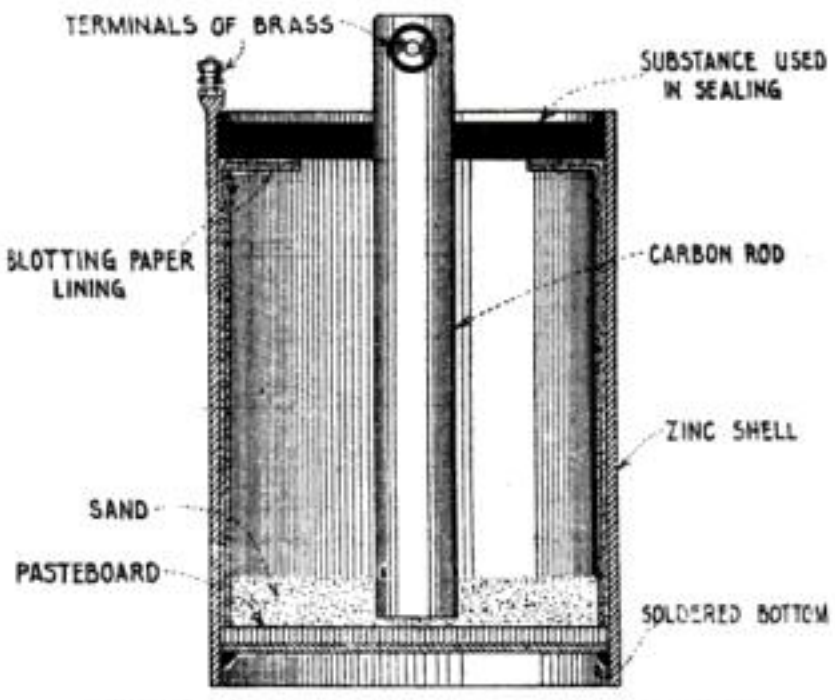
This signal, while especially built for this purpose, is only suggestive and may be used in many like places as a safety device that will always signal when a certain necessary piece of work must be done on a set time, which may otherwise be forgotten by a careless operator or watchman.—PAUL JUSTICE.

Constructing a Dry Cell Which Can Be Renewed

PROCURE 1 lb. of chloride of zinc crystals, and dissolve them in about 1 quart of distilled water. Stir, until all the crystals pass into solution, adding more water if necessary. After all the crystals have dissolved, pour the solution into a clean vessel, and add enough distilled water to make up 2 quarts. Add 1 lb. of sal ammoniac to the solution, and stir it until the crystals have dissolved. Have a vessel ready to receive the contents. Then the prepared solution can be set aside for future use, after the vessel has been labeled "battery solution."

The cell is constructed, as shown in the accompanying illustration, from a zinc-lined can and blotting paper. Moisten the blotting-paper lining with the battery solution, and pour off all excess liquid. Permit the blotting paper to become almost dry. Mix finely powdered manganese and carbon with a small quantity of the battery solution until it has acquired the consistency of a stiff paste. Put the carbon center post in the can, after having covered the bottom of the can with a layer of sand about ¾-in. thick.

The can is then ready to receive

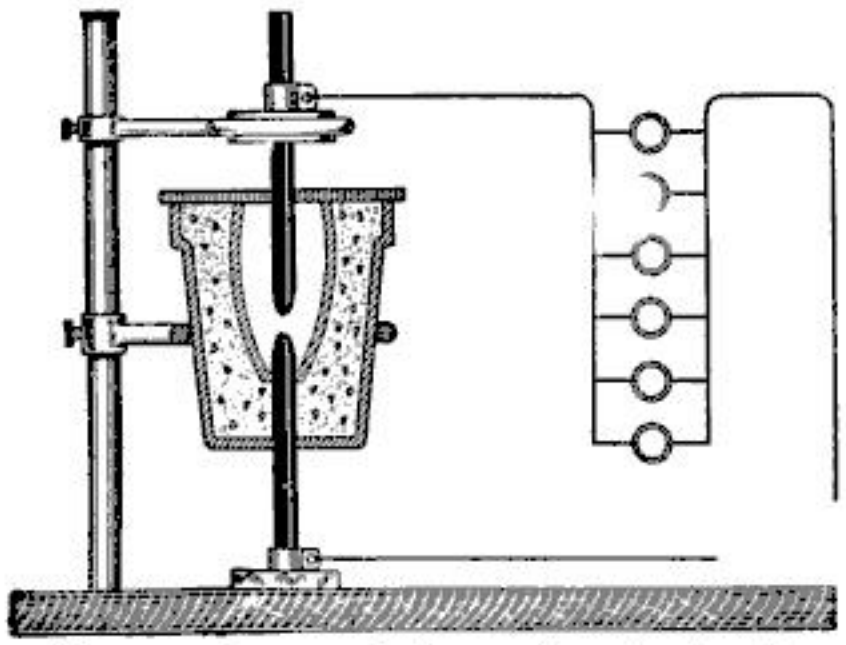


Sectional view of dry cell in which the contents may be removed and renewed

the paste, which should be packed down hard with an improvised ram. The top of the cell should be sealed with paraffin, or a similar substance that can be removed easily, in order that the cell may be renewed at any time with little or no trouble.—HERMAN NEUHAUS.

How to Make an Electric Laboratory Furnace

IN the laboratory, it is often desirable to secure heat greater than that produced by the Bunsen burner, or even a greater range of temperature than can



Flower pot suspended on a ring stand and holding crucible to melt metals electrically

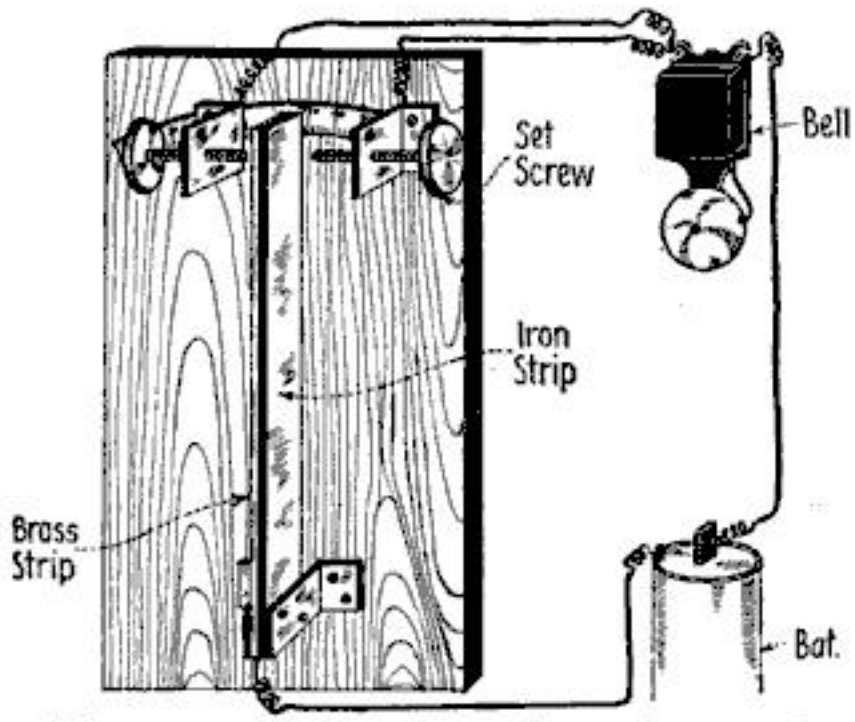
be reached by the Scimatco burner. This makes the use of an electric furnace necessary. A furnace that can be constructed by any amateur is herein described. It is very convenient to handle, and the materials that are utilized in it, can for the most part be found in the laboratory. The terrific heat generated by this furnace is capable of reducing alumina. Its other uses are familiar to all those who work in the laboratory.

As can be ascertained in the accompanying illustration, one of the most essential parts of the apparatus is the two-ring stand which serves as a support for the main part of the furnace. The rings support a flower pot, in which is placed a small crucible, made either of porcelain or alundum, according to the work that is to be done by the electric furnace. The crucible should be placed in the flower pot in such a manner that it may be readily removable when necessity arises. The space between the flower pot and the crucible is filled with pulverized fire-brick, but if that cannot be obtained, the fire-brick may be of the ordinary granulated variety. A sheet of thick mica covers the top of the furnace, and a hole is bored in it to permit the passage of the carbon. This carbon is supported by the upper ring which has been provided with an asbestos plug to hold the carbon stationary. A brass ring prevents the carbon from slipping, and forms a means of regulating the distance between the carbons. The other carbon goes through the bottom of the flower pot, and through the crucible, which has previously had a hole that fits the carbon snugly drilled in its bottom. The lower carbon rests upon a block of wood or asbestos which is placed on the base of the stand. The terminals of the furnace are shown in the illustration. To secure best results, the lead-in wires should be of No. 14 copper wire.

The furnace requires from six to eight amperes of current, using a direct or alternating current of 110 volts connected with incandescent lamps as shown, or with a water rheostat. At first, it is advisable to operate the furnace empty, in order to ascertain whether the apparatus stands up well under the terrific heat generated. It is also strongly advised that the operator use smoked glasses when the furnace is in play, as the glare produced has an unpleasant effect on the eyes.—HERMAN NEUHAUS.

Thermostat Made from a Brass and an Iron Strip

IRON and brass expand to different lengths at the same temperature and for this reason these metals are ideal for



The two metals riveted together and mounted on a base to operate an electrical system

making a thermostat. I took a piece of iron 12 in. long, ¼ in. wide, and 1/16 in. thick and riveted it to a similarly shaped strip of brass. This compound strip I

fastened by its lower end in a vertical position to a wooden base 10 by 16 in. Near the upper end of the strip, and on either side, I mounted setscrews.

The distance between the upper end of the compound strip and the setscrews can thus be regulated as desired. The lower end of the strip, I wired to a battery and bell, then from both setscrews to the bell as shown. By this means, the bell is rung when the room becomes too warm or too cool. In either case, the circuit is made by the compound strip bending until it comes in contact with the setscrew. The dotted line shows the thermostat bent to the right because the heat in the room has expanded the brass faster than it did the iron. This rings the bell.

In the same way, when the brass contracts faster than iron, the strip is bent to the left.

The distance between the setscrew end and the strip can be regulated so that the bell rings at any desired temperature. A scale can be marked upon the wood back of the upper end of the strip, for convenience. This will vary for every thermostat made and should be determined by using a thermometer. When the bell rings, I look at the thermostat to see whether fires need starting up or shutting off. The bell is easily silenced by slipping a piece of rubber between setscrew and strip. This breaks the circuit and the rubber falls as soon as temperature approaches normal and the strip comes back to its perpendicular position. When the iron strip is riveted to the brass, the two metals should be kept in the normal temperature, say at a temperature of 65 deg. for an hour before fastening them together. In this way the compound strip will always be perpendicular when the room is at about the right temperature.—F. E. BRIMMER.

Finding the Polarity of Electric Wires with a Potato

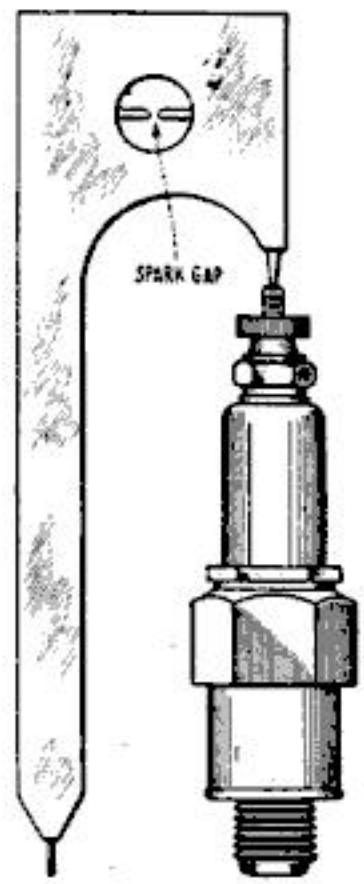
THE amateur electrical experimenter often finds it necessary to know which wire is the positive wire for making proper connections to his apparatus.

The positive pole of a wire or of an electric battery can very easily be found by means of an ordinary potato. Cut the potato in half, lengthwise. For a low direct current voltage of 1½ volts to 10 volts, place the wires to be tested a short distance apart in the potato.

The positive pole part of the potato will turn green, while the negative one will remain colorless. This method can be used to find the polarity of one dry cell and upwards to 500 volts direct current; the only difference in using the higher voltage being that the wires require to be further apart. In using the 110 volts pressure, the time necessary to determine the polarity is about 10 seconds. With a current of say 2 volts and upward to 10 volts, it will require about one minute. If electrical workers will always carry a potato in their tool bag, they will have a reliable polarity indicator. The method cannot be used on alternating currents, as both ends of the wires would turn the potato green.—W. S. STANDIFORD.

A Spark Plug Tester with an Inclosed Spark Gap

A VERY simple and convenient tester for spark plugs on automobiles, motor boats, motorcycles, etc., is shown in the accompanying illustration. The body of the tester is of hard rubber in which is imbedded the metal contacts, and the spark gap is protected by glass discs. The nature of engine trouble can be quickly diagnosed by application of this tester. It shows at a glance, what otherwise might require an overhauling of the engine to discover.



A spark gap is inclosed in the hard rubber tester

A regular spark shows a good plug. A non-spark shows a short circuit. An irregular spark shows defective porcelain. A clear spark shows that the trouble is in the mixture and indicates no power. A knock in the motor will be magnified, and the cylinder in which it occurs can be located.—FLOYD L. DARROW.

Electrical Devices and How They Work

Secondary Cells; Storage Batteries—II

Accumulators are cells of battery that will receive a charge of electricity and keep it stored until it is released through mains for power and light

By Peter J. M. Clute, B. E.

IN the primary cell, electric current is produced by the decomposition of the electrolytic solution and the consumption of a zinc electrode. In other words, the varying natural potentials of two substances, such as zinc and copper or zinc and carbon, constitute the original impulse to a succession of reactions whereby chemical energy is transformed into continuous electrical energy. On the other hand, in the secondary, or storage, battery, electric current is generated by a somewhat similar chemical reaction, originated, however, by chemical changes, produced by an electric current passed through the cell at the start of operations. This operation is termed the charging of the cell.

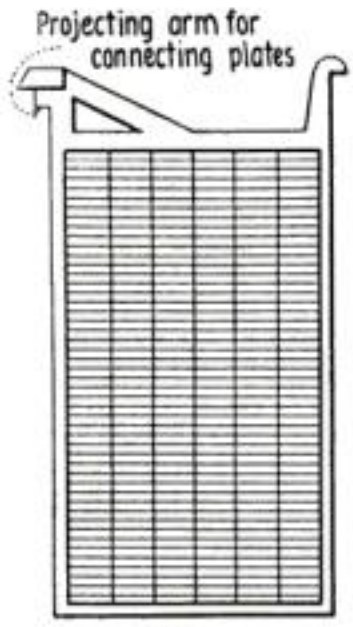


Fig. 1

Positive lead grid of a storage cell

Such cells are called secondary cells because their action is dependent upon the effects of the energy impressed upon them by a primary electrical source. They are designated as storage batteries because, apparently, a quantity of electrical energy is stored in them in the form of current, to be delivered, also in the form of current, when the battery is connected as a source of electricity.

Storage cells of all descriptions are charged from D. C. service mains, or from special charging generators. The current may be regulated to the required rating by suitable resistance, usually through special switchboards, designed to meet the requirements of charging. If the only available current supply is alternating, it can be transformed into direct current by means of a rectifier, or a motor-generator set. The secondary cell is capable of being recharged after exhaustion by passing an electric current through it in a direction opposite to that of the current on discharge. This difference constitutes the principal advantage of the storage battery over the primary cell.

The typical storage cell is the lead-lead couple in an acid electrolyte. There are, however, other varieties of such cells, all of them more or less experimental in character. These may be designated as lead-copper, lead-zinc, alkaline-zincate, etc., all using corrosive electrolytes. In addition to these, and in a class by itself, is the Edison nickel-iron cell, using an alkaline and non-corrosive electrolyte.

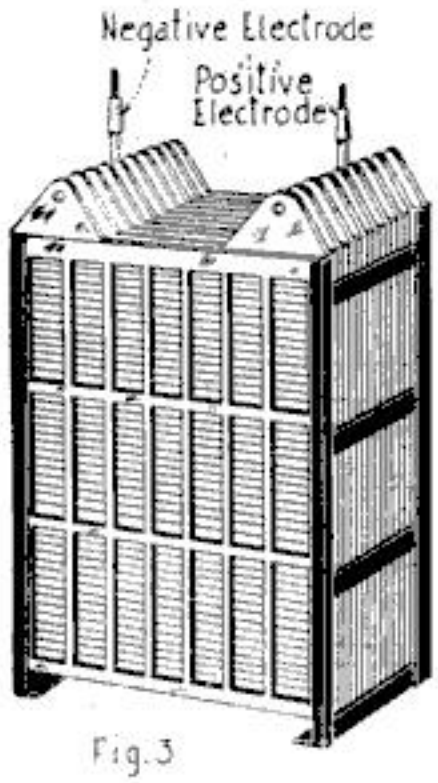
The commercial storage cell consists of an even number of positive plates and an odd number of negative plates, immersed in a dilute electrolyte (generally sulfuric acid) contained in a jar or box of non-conducting material. The plates are arranged alternately positive and negative, and are cast with a projecting arm as shown in Fig. 1, so that all positives may be connected by a single stud, and all negatives similarly united—each such unit of several plates being one element of the cell. The positive terminal at which the charging current enters the cell, passing to all positive plates, and at which the current leaves the cell on discharge, is called the anode. Similarly, the negative

Fig. 2

Positive plates of perforated steel tubes

terminal, at which the current emerges after passing through all the negative plates, during charging, and at which the current enters, on its return path on discharge, is called the cathode.

The conditions in operating a storage cell are most exacting, and serious complications are liable to follow violation of the rules. Thus, it must neither be charged nor discharged too quickly, there being safe average rates in both cases. It should never be over-charged or over-discharged beyond the safe limits prescribed. The voltage at full charge should not exceed 2.6 volts, and its working pressure not more than 2 volts. On normal discharge, it should not be permitted to fall below 1.75 volts. The discharge capacity of a storage cell (its current rate) is measured in ampere-hours, which are found by multiplying the current in amperes by the number of hours at which it can flow at not less than 1.75 volts. In order, however, to standardize, the normal discharge rate is assumed to be at 8 hours. In the main, the ampere-hour capacity decreases with increase in the current rate.



Grouping of positive and negative plates

The ideal storage battery or accumulator is an electrolytic cell in which electrical energy may be stored as chemical energy until ready for use. It must be capable of returning at any time all, or any part, of the electrical energy put into it; and when discharged, the cell must be in its original condition. It is, therefore, necessary to find a perfectly reversible chemical reaction whose direction and energy relation is perfectly controlled by the electric current. That is, no chemical action should take place except that which necessarily accompanies the flow of useful current when on charge or discharge; and secondly, the quantity of material whose chemical composition is changed should be proportional to the quantity of electrical energy passed through the cell.

The nearness of the plates to each other and the large surface obtained by using a number of plates, cause the resistance of the cell to be very small. The greater the number and size of the plates in a cell, the larger the current that can be sent through it without injury to the cell.

The commercial importance of such storage cells is due in part to their extremely small resistance, and to the fact that they can be renewed not by means of costly chemicals, but by a current obtained from a dynamo, driven by engine or water-power.

Making a Wet Battery from Ordinary Dry Cells

WHEN a dry battery of an electric door became exhausted and there was no sal ammoniac on hand to renew it, it was decided to try in its stead some hyposulphate soda. After removing the cardboard wrappers from the cells, a number of perforations were made in the zinc casing, then the cells were placed into wide-mouthed fruit jars, into each of which was put several spoonfuls of the salt and enough water to fill them within 1 in. of the top. If the water should cover the cells, it will cause a short circuit.

Upon testing the battery, while the cells were still in the jars, it was discovered to be fully as powerful as one composed of new dry cells. Then the experiment was tried of using it just as it was—a new type of wet battery. It has proved so effective that after a year of use it has required no other attention than that of replacing the water evaporated. Thus, at no expense, excellent results have been obtained, and the cost of several dry cells saved.—F. M. WAGNER.

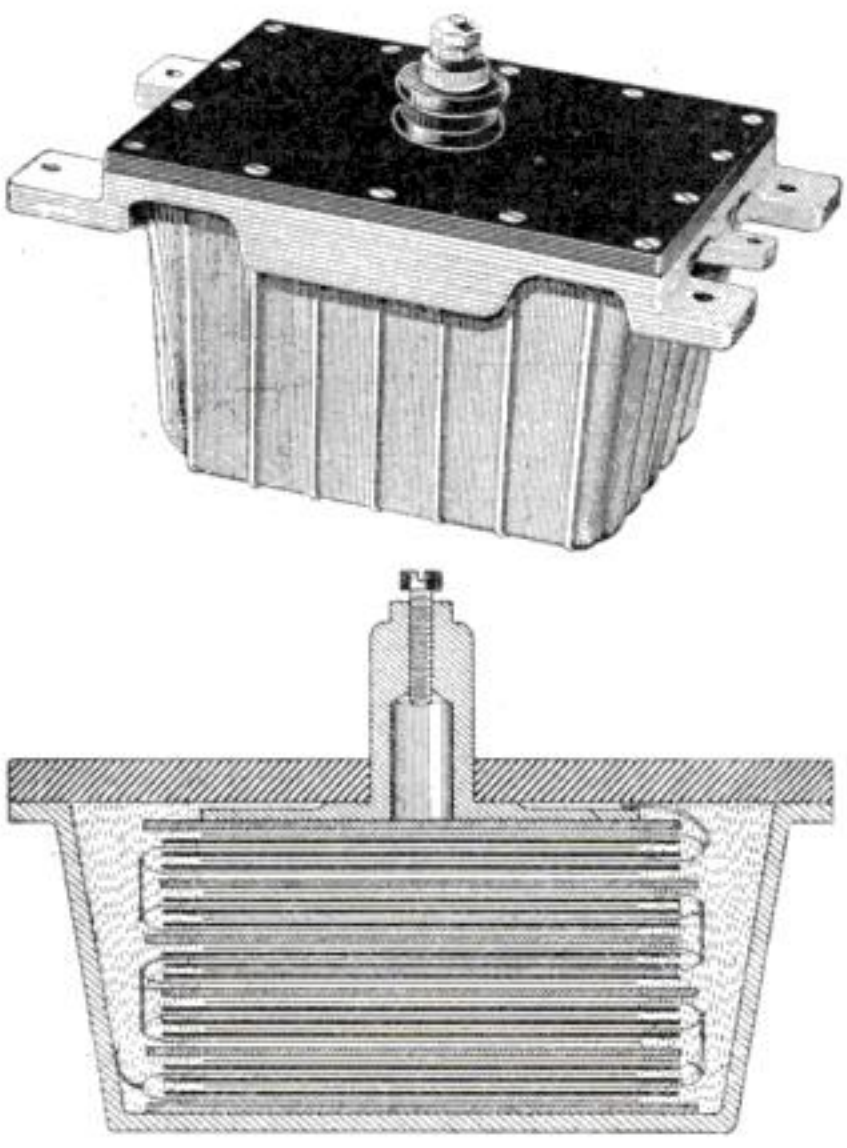
Coating a Tin Oil Can to Prevent Rust

A COMMON tin oil can may be made rust proof if it is given a coat or two of paint, especially on the bottom. It is worth while, occasionally when through painting, to wipe off the paint brush on the bottom of the old oil can, just before the brush is laid away.—JAMES M. KANE.

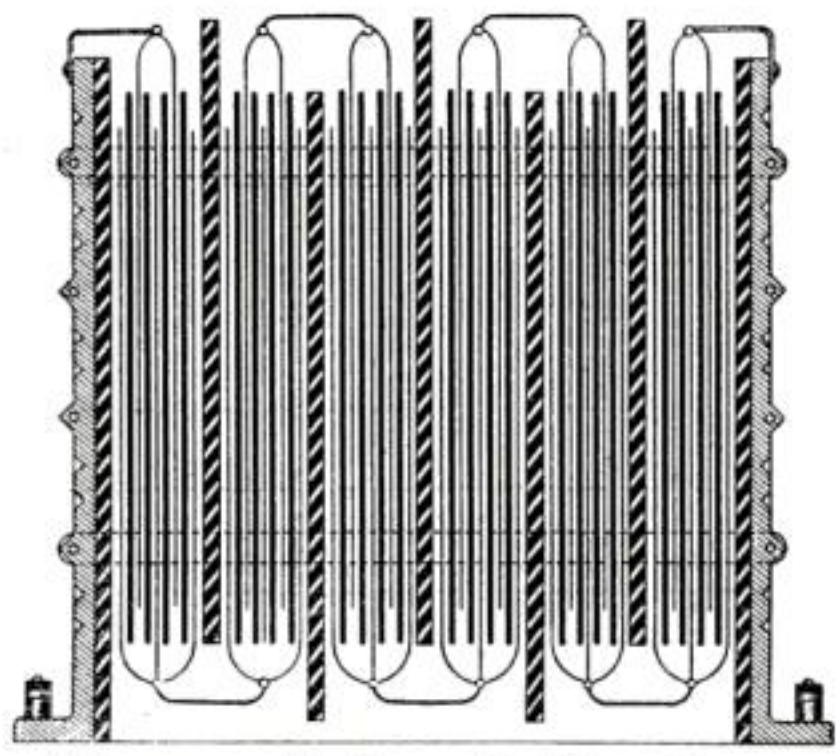
A New Condenser to Protect Wireless Generators

IF a layman were shown about the wireless cabin on board a battleship, without a doubt he would consider the rack of condensers about the least important part of the equipment. The experienced amateur knows better. He knows that should the condensers break down, the entire sending machinery is likely to collapse. Even leaking condensers may cut down the efficiency of the station so that it would be difficult, if not impossible, to comunicate over a long distance. Think what this would mean if a warship were on a scouting cruise and discovered something important!

Though it is not generally known, an accident such as this was always threatening to isolate the ships of a fleet, not very much more than a year ago. Most ships were using glass Leyden jars or glass plate condensers at this time. The immense voltages across the high-tension transformer that the jars had to stand, continually broke them down under the prolonged strains, and only protective condensers across the wireless generator, saved it from utter destruction. Moreover,



A condenser built of several units, which are insulated from one another as well as each of the plates within each unit



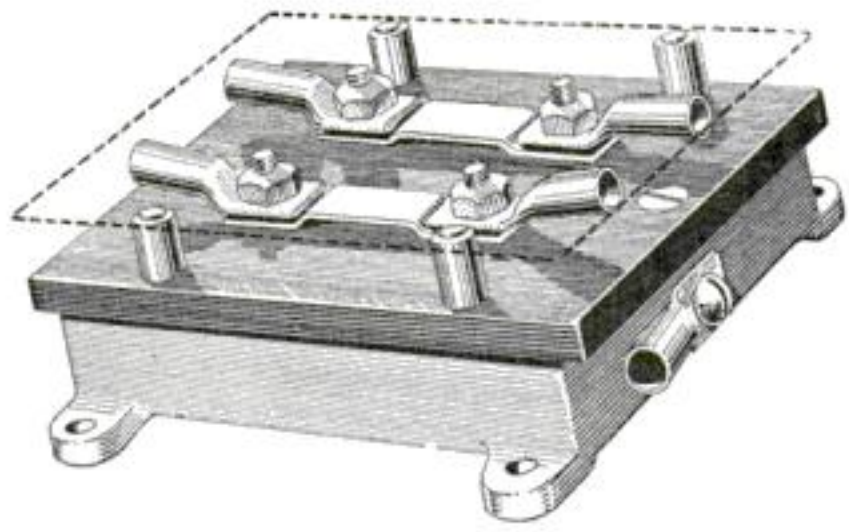
The same method is used in this condenser, although it is of very different construction

brush discharges invariably took place through the glass of the condensers. These discharges increased in intensity as the glass weakened with use. The discharges contaminated the air with ozone, which made it hard for the operators to work; to say nothing about the decrease in the sending power that they produced.

The Navy Department has now eliminated the glass condenser, and thus has done away with its disadvantages. A mica condenser, the development of William and Philip Dubilier, of New York city, is now used exclusively. This condenser is made up of a number of units connected together in series. The result is that the full potential across the transformer is divided a good number of times before it acts across any of the units. The voltage that does result across a single condenser is correspondingly small; too small, in fact, to set up any detrimental brush discharge action. Such sets of condensers ought to be highly efficient, and, theoretically, ought to last a life time.

Each of the units is built up of alternate sheets of copper foil and mica, the copper foil being connected in multiple as in ordinary mica condensers. Though the probability of a breakdown of the mica has been made exceedingly small, the chances of such a breakdown injuring the station has been made

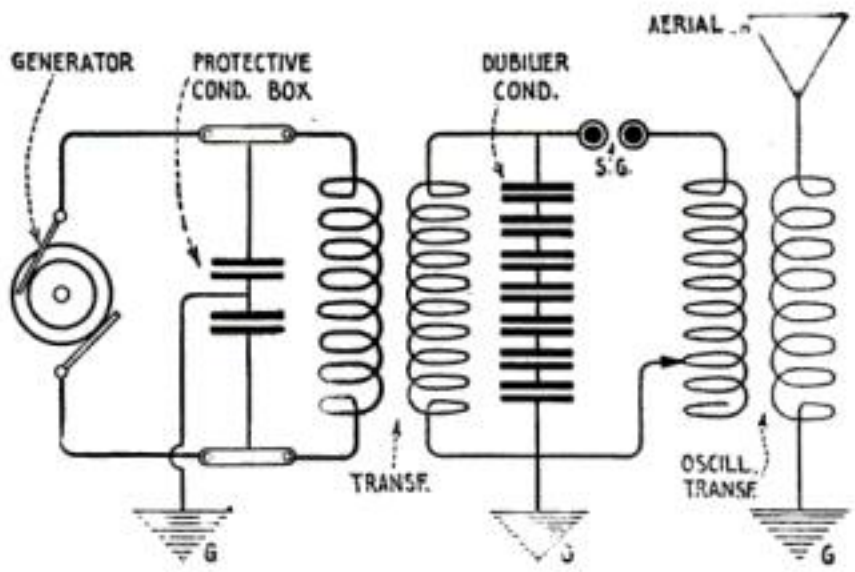
further improbable. The thickness of the mica sheets has been so proportioned to those of the metal leaves that when a hole is burnt through the dielectric, a



Construction of the casing for a condenser with lead-in terminals attached. The dotted line shows the protective cover

larger hole is burnt through the foil. Hence, in this condenser, two oppositely charged pieces of foil cannot come together through the hole made by the leaking currents. The condenser is truly self-healing.

As a last precaution against its being burned out by a short circuit, the generator has the pair of protective condensers shunting it. For these condensers, the Navy officials have also adopted a Dubilier invention, in which two of their condensers are placed. Besides its reliability, the Dubilier device is also foolproof. For, as the diagrams show, should their condenser be removed from the



Hook-up showing positions of condensers in the line and how the connections would not be complete without them

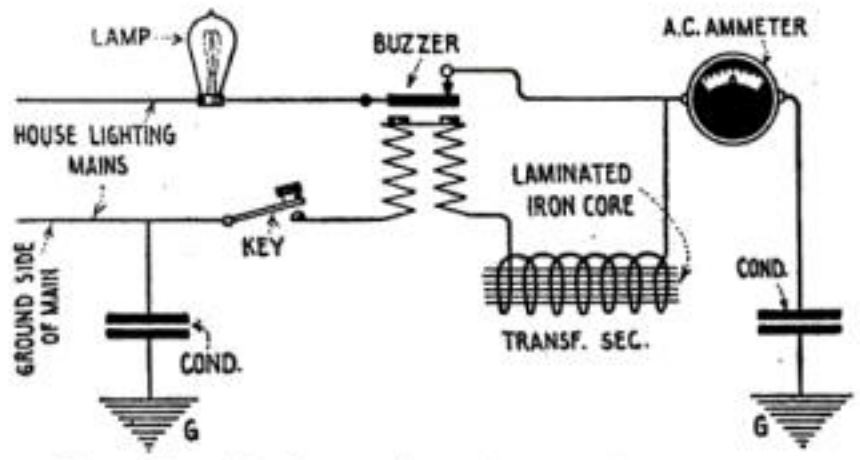
circuit, the generator connections would not be complete until another box of protective condensers is connected with the circuit.

Increasing the Range of the Ground Wireless Station

IN experimenting with inductive coils, placing them with the buzzer in the ground circuit, to see if increasing the inductance would not send larger currents into the earth, it was found that the sending range could be increased in this way to a considerable extent.

First, the contact connections of the buzzer were changed as shown in the diagram. The secondary of the sending coil was connected between the buzzer contact and the buzzer coils, and to vary the inductance, the laminated iron core was moved in and out. For some stations, of course, the ordinary variable radio loading coil will do the trick just as well.

Naturally, the sending range will be largest when the buzzer is vibrating well and the maximum current is sent into the



Considerably increasing the sending range of a ground wireless station, by the use of an induction coil placed with the buzzer

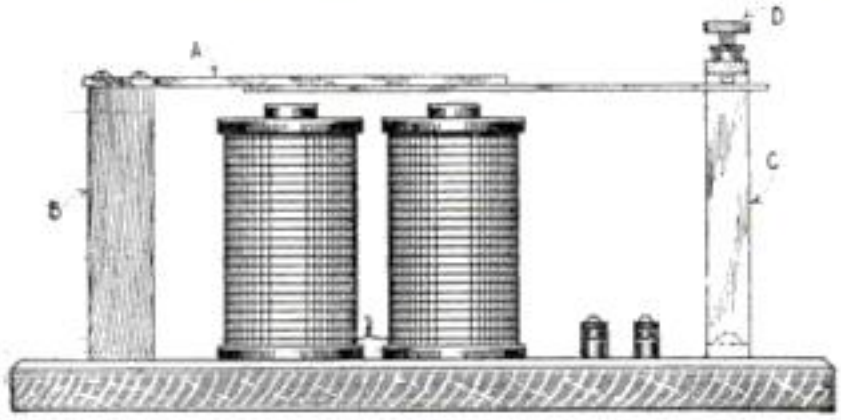
ground. Therefore the inductive coil should be tuned as in radio work, until the ammeter in the earth circuit registers the largest current.—E. T. JONES, Chief Electrician, Radio, U. S. N. R. F.

Where Fiber May be Used as a Fireproof Material

FIBER is an almost fireproof material. Almost—for it will burn. But, unless it is kept on fire by some outside source it will go out, and it requires a very hot flame to ignite it. So, when anyone wants to use fiber in a situation exposed to heat, he can do so. There is little danger of its burning except when it is in the direct path of a flame. The close texture of this material prevents a flame from taking hold unless forced by a draft.

A Telegraph Sounder Made from Old Bell Parts

THE sounder here illustrated is made entirely from an old bell, with the exception of only a few of the essential parts. The magnets on the bell are first



Old bell parts mounted on wooden base with attachments to make a telegraph sounder

carefully removed and screwed to the base as shown. The soft iron armature is next removed and the spring attached to it is taken off. It is then soldered to a brass strip which is shown in the accompanying illustration at *A*, and fastened to the wooden support at *B*. The bridge, *C*, is constructed of brass, but a more ductile metal may be substituted if the brass cannot be worked with the materials at hand. To obtain the best results, a small adjustable screw *D* is used to regulate the stroke of the armature. The drawing makes all other directions and constructions clear.—HERMAN NEUHAUS.

A Secret Code of Colors for Transmitting Messages

FOR Boy Scouts and others desiring to communicate by means of a secret code, the one described will prove very acceptable. The code is very simple, being composed of color combinations, each combination representing a single letter of the alphabet. Thus, it will be seen that the combination, red and yellow (ry) represents the letter A; red and blue (rb) B, and so on.

In this manner, any message can be sent, with the assurance that only the person for whom it is intended, can read it. All the colors, which are used in the following code, can be obtained by buying an ordinary box of crayons.

In writing out a message, always leave a small space between each letter and a much larger one between words.

The following code can be changed, as it is only an example.

R-red; y-yellow; b-blue; g-green; p-purple; o-orange; br-brown; bla-black.

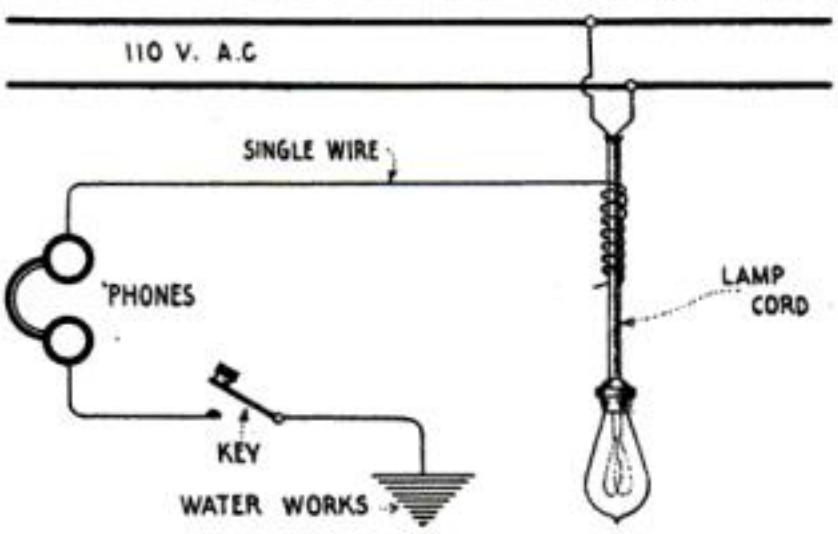
A-ry	J-yp	S-gp
B-rb	K-yo	T-go
C-rg	L-y br	U-g br
D-rp	M-y bla	V-g bla
E-ro	N-bg	W-po
F-r br	O-bp	X-p br
G-r bla	P-bo	Y-p bla
H-yb	Q-b br	Z-o br
I-yg	R-b bla	period-r

Only Uncut Diamonds Are Used to Dress Emery Stones

DIAMONDS are used to sharpen and shape emery wheels. But even if anyone were so foolish as to use it, the diamond of the jewelry shop would not do the work well, for it is the natural face and edge of a diamond that does the cutting on such work. Therefore the polished stone of the engagement ring would be of little or no value as a stone dresser.

Practicing the Telegraph Code Without a Battery

THE illustration shows how to connect phones with a key, so that sounds may be heard, similar to those produced in a radio transmitter. This plan cannot be used on direct current mains. It takes the pulsations of an alternating current to produce the effect. About 10 turns of No. 22 gage, single



Separate hook-up to an alternating current line for producing sounds like radio

cotton covered wire is wound around the drop cord, and when the lamp is turned on to get a flow of current, the hook-up is ready for practice.—E. T. JONES.

The Normal Running Temperature of Electric Machines

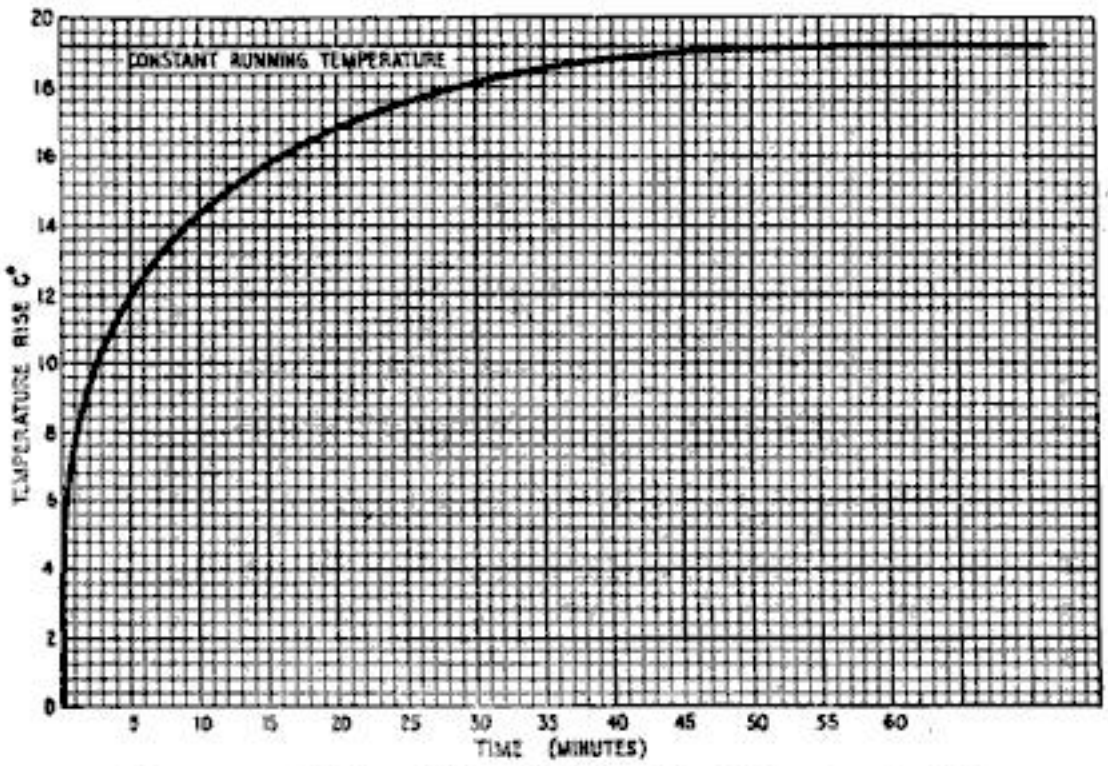
AN electric current flowing through a conductor tends to raise its temperature, especially where there is a resistance offered. In electrical terms, this is proportional to the square of the current. In designing electrical machines, this heating is kept down as much as possible, since it represents a waste of energy and is apt to char the insulation and cause damage to the machine.

It is evident that the heating up of a machine will take some time, depending on the size and cooling ability. The temperature will rise until finally a value is reached at which the temperature remains constant. This is the normal running temperature of the machine. For cotton insulated windings, it should be below 85 deg. C. For this reason, other materials, such as asbestos, mica and enamel, have been developed for purposes where the heating effect is great.

The method of procedure for the heat run of the electrical generator is as follows: Two or three thermometers are stuck to the filed coils and core of the machine with putty. Read the thermometers and record the readings; then start the generator. Allow the generator to feed normal current to a water rheostat or feed it back into the line. This latter method of using the current is in general practice because of its economy. Take thermometer readings every five minutes for at least an hour and then shut off the power and take armature core and winding temperatures. Suppose the set of readings is as follows:

Time	Temperature	Temperature Rise
12 : 00	21 deg. C.	12
12 : 05	33 " "	12
12 : 10	35 " "	14
12 : 15	36.5 " "	15.5
12 : 20	37.2 " "	16.2
12 : 25	38.5 " "	17.5
12 : 30	39 " "	18
12 : 35	39.5 " "	18.5
12 : 40	39.5 " "	18.5
12 : 45	40 " "	19
12 : 50	40 " "	19
12 : 55	40.1 " "	19.1

Plot the data as given, with temperature rise as ordinates and time as abscissas, and the curve, as shown, will be obtained. By studying the curve, it will be noticed that the temperature of the machine rises rapidly at first and then gradually approaches a constant temperature. The reason for this is that heat transfer between the machine and the surrounding air will depend on the difference in temperature between them. At first, there is little difference in temperature between the machine and the air and therefore, almost all the heat goes to warm up the machine. But when the machine gets warm, it dissipates the heat rapidly and reaches a final temperature at which the heat generated by the current equals the heat dissipated.—Alex V. Polson.



A curve obtained by plotting the data given with temperature rise as ordinates and time as abscissas

A New Use for Fogged Photographic Plates

SOMETIMES, by accident a photographic plate is fogged by exposure to light before it is exposed in a camera or before it is developed. These plates can be used to make a very soft negative from a harsh one. The method is as follows: Place the fogged plate in a printing frame with a negative, film against film. The plate prints slowly and makes a positive. In broad daylight it is placed in the developer and the positive disappears slowly, the plate gradually becoming a negative. After several experiments, it was found out that the shorter the printing, the harsher the negative became. Long printing is best.—W. S. Standiford.

Wireless Work in Wartime

VII.—Fundamental Principles of Radio Apparatus

By John L. Hogan, Jr.

THE six preceding articles of this series comprise a fairly complete set of instructions in learning wireless operating, from the simple viewpoint of telegraphing. Memorizing the code, reading Morse signals by sound, and practice in overcoming the difficulties of "station" and atmospheric interference have been taken up in some detail. All of these matters are essentials in the study of radio telegraphy, and they must be completely mastered if one is to become a first-rate operator. To be of the greatest value in radio work, however, and to advance in the naval, military or civilian radio services, it is important to be more than a skilled telegrapher. In addition to the ability to transmit and receive messages swiftly and accurately under even the most adverse conditions, one should know how and why his instruments work. Such technical knowledge is of the greatest use to the radio man in war work, for without it he is likely to be unable to make urgently needed repairs and adjustments. This, and the succeeding articles will go into the simple technology of radio telegraphy, and should prove helpful in studying to qualify as one of the expert radio workers who are and will be so much needed in the Signal Corps and the Naval Communication Service.

The main purpose of these articles, then, is to guide the student to a thorough understanding of the radio station, and to point out the precautions which must be taken if the best possible working is to be obtained. This will involve both the discussion of apparatus design, and the elementary theory of radio telegraphy. These two branches of the general art are so closely interwoven, however, that it is scarcely possible to tell where one stops and the other begins. One cannot design and build good radio apparatus, or operate it most effectively, without having a genuine appreciation of what it is to do and how it can be made to do it. Neither can one understand the theory in such a way that it will prove really useful to him, unless he has also a knowledge of the practical apparatus to which the theory applies. In these articles the concrete elements of design and operation and the reasons for them will be carried along side by side. The only theory used will be working theory, and the only constructional points explained will be those which have been found satisfactory in the experience of radio engineers in the military and commercial fields.

The Elements of Signaling Systems

To understand the radio transmitter itself we should fully understand its object. In the first place, then, let us consider the essentials of any communication system. Just as the natural act of

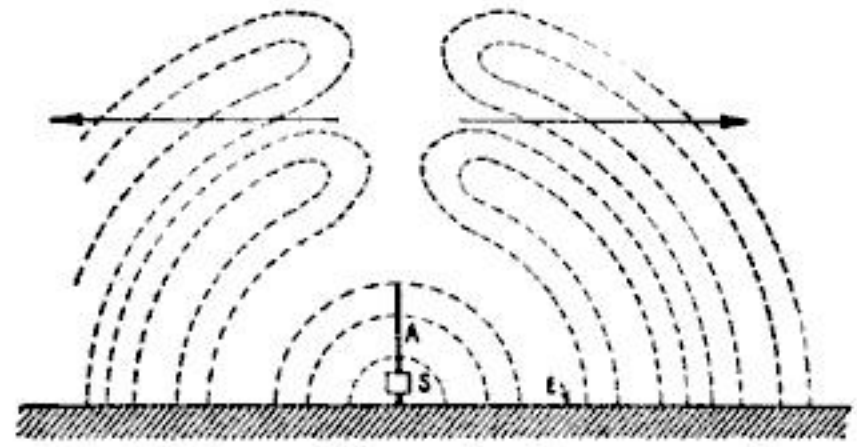


Fig. 27: General form of radio waves as they pass from the sender in direction of arrows

speaking to another person in the same room calls into play the three main elements of any system for the transmission of intelligence, so does the sending of a wireless message involve these same three things. We cannot convey ideas from one point to another without having something which can act as a transmitting medium connecting the two points. In the wireless telegraph, the connecting medium is the so-called "ether" of space, which lies between the two stations. In talking, the medium of transmission is the air which lies between the speaker's vocal cords and the listener's ear. In both cases, the medium is vibrated according to some pre-arranged code, and the vibrations pass from the sender to the receiver.

Evidently, the two remaining elements are the transmitter and the receiver. The first of these is merely an apparatus which

can in some way set the air, ether or other transmitting medium into vibration; the second is an instrument which is capable of indicating the presence of the vibrations. In speaking, the human apparatus consisting of the mouth and vocal system produces sound-waves, or compressional vibrations, in the air. The sound waves vary in intensity and pitch (or frequency) according to the signaling code with which we are all familiar and which we call a language. When the air vibrations reach the ear of the listener, they are re-converted into the sensation known as sound, and their presence is thus indicated.

The Basic Process of Radio Telegraphy

In radio telegraphy the process is identical, from the broad viewpoint. As shown in Fig. 27, a sending apparatus indicated diagrammatically by the box marked *S*, is connected with an elevated aerial wire or antenna *A* and with the ground *E*. The sender *S* sets up high-frequency currents in the wire *A*, and the rushing of these charges up and down at the rate of hundreds of thousands of complete trips per second creates vibrations or waves in the ether, which surrounds the sender and extends indefinitely into space. The general form of these waves is shown by the dotted lines in Fig. 1 and the way in which they pass off from the sender is indicated by the arrows. Just as the sound waves travel through the air and ordinarily produce no appreciable effects until they reach the receiving ear, so do the radio waves pass through the ether. They are invisible and inaudible, and produce no appreciable effects until they strike such a conducting body as an elevated aerial wire. When an antenna structure of this kind is reached, as shown in Fig. 28, the waves set up in it a series of small high-frequency voltage (or electrical pressure) impulses, first in one direction and then in the other. These minute voltages cause high frequency currents to flow in the antenna wire *A*, and these, passing rapidly to and from the ground connection *E* through the receiving apparatus indicated by the box *R*, produce an indication which announces the arrival of the radio waves. If the waves are sent out in groups corresponding to a pre-arranged code, or if their intensity or frequency is modified according to the code, messages may be transmitted.

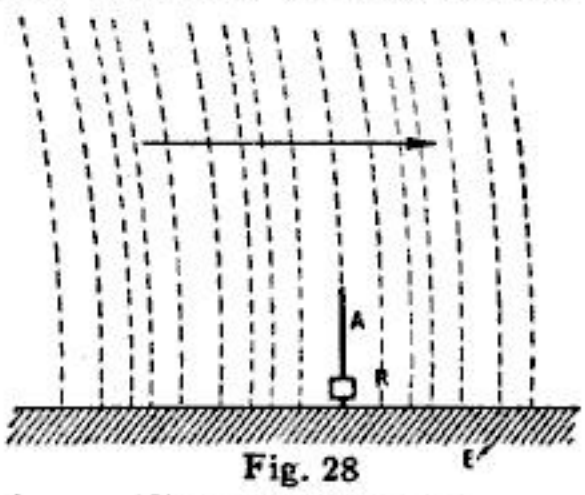


Fig. 28
The waves as they reach the receiver

Thus, the object of the radio transmitter is to produce high-frequency currents in an elevated aerial wire system and to provide for the control of the current-production in accordance with some signaling code. This brings us to the first problem of radio-telegraphy, namely, the production of the high frequency currents. Before it can be considered we must reach a conclusion as to the numerical value of the frequencies involved.

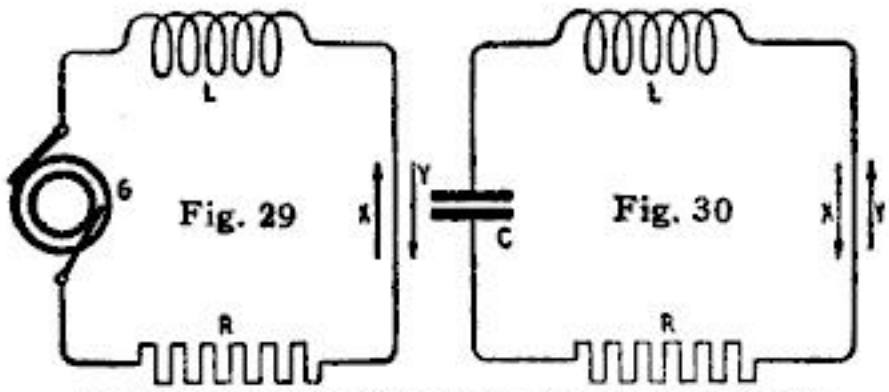
Audio and Radio Frequencies

Frequency itself, in the abstract, is merely the number of times something happens in a given interval. The postman who delivers 400 letters in his eight-hour working day is evidently giving out mail at the rate of 50 letters per hour. If a water tank holding 8,000 gallons springs a leak and becomes empty in four hours, it is clear that the water is lost at the rate of 2,000 gallons per hour or $33\frac{1}{3}$ gallons per minute. If a sound wave is produced by a siren which ejects 256 small puffs of air in each second, the wave consists of 256 compressions and rarefactions per second and corresponds to the tone of middle C on the musical scale.

Sound frequencies range roughly from 30 per second to 10,000 per second, and air vibrations which occur at rates either lower or higher than these respective extremes are ordinarily inaudible. Such frequencies as lie within these limits are called "audio frequencies," for convenience. They correspond to various musical tones, and to the electrical current frequencies which would produce those tones by passing through the ordinary magnetic telephone receiver. A frequency of 60 cycles per second, which defines an electric voltage or current alternating in direction completely 60 times per second, would produce a tone a little lower than that of the second C below middle C on the piano. Sixty cycles is a standard alternating current frequency; 500 cycles per second, in which the reversals occur over eight times as often, produces directly

the tone slightly below the next C above middle C, and is much used in radio telegraphy. Both of these are audio frequencies.

Frequencies of above 10,000 cycles per second are called radio frequencies, for the reason that they are most useful in producing radio waves. Wireless telegraph trans-



A closed circuit with alternator, and a closed oscillation circuit for alternating currents

mitters use frequencies as high as several million per second, which are, of course, far above the upper limit of sound or audio frequencies. Since currents of these enormously high frequencies are used in the antenna circuits of wireless transmitters, the problem under consideration becomes how to generate such electrical movements.

Machine Generation of Alternating Current

There are two practical methods of producing alternating currents over large ranges of frequency, as indicated in Figs. 29 and 30. The first of these shows an alternator or alternating current generator G connected in series with a coil of wire or inductance L and a resistance represented by R. The generator G usually consists of a machine in which coils and magnets are moved relatively to each other at comparatively high speeds, so that the coils have induced in them voltages which change in intensity and direction from instant to instant. The series of alternating voltages thus produced, when applied to the circuit, first in the direction of the arrow X and then in that of Y, gives rise to an alternating current through the resistance R and inductance L. The frequency of this alternating current depends entirely upon the frequency of the voltage impulses; if the voltage is applied 500 times per second in the direction of either arrow, the current will have a frequency of 500 cycles per second. For any given strength of voltage, the amount of current will depend upon the amount of effective inductance and resistance in the circuit, and will be less, the larger the inductance and resistance. The number of times the voltage impulses in one direction are applied per second, or the frequency, depends upon the construction of the generator G; the higher its speed, or the greater number of magnetic poles and corresponding coils it has, the higher the frequency of the current. This mechanical method of direct generation is used almost exclusively for production of the commercial alternating currents at frequencies from 15 to 500 per second. For radio transmitters, special generators which produce frequencies as high as 200,000 per second are built and used. Still higher frequencies can be reached by machine generation of this type, particularly if some sort of frequency transformation is involved.

Generation by Condenser Discharge

The second important method of generating alternating currents is that of the condenser discharge, as shown in Fig. 30 Here an electrical condenser C is connected in series with the resistance R and inductance L, to some extent taking the place of the generator G in Fig. 29. If we imagine an electric charge to be placed upon the condenser plates and the circuit then to be closed as in Fig. 30, it is not hard to realize that the voltage impressed on the circuit by the condenser charge will cause a current to flow in one direction, say that of the arrow X. The interesting feature of the arrangement though, is that when the resistance is not too large as compared with the capacity and inductance, the current will keep on flowing after the condenser has discharged itself fully, and will in fact recharge the condenser to some extent in the opposite direction. By proportioning the cir-

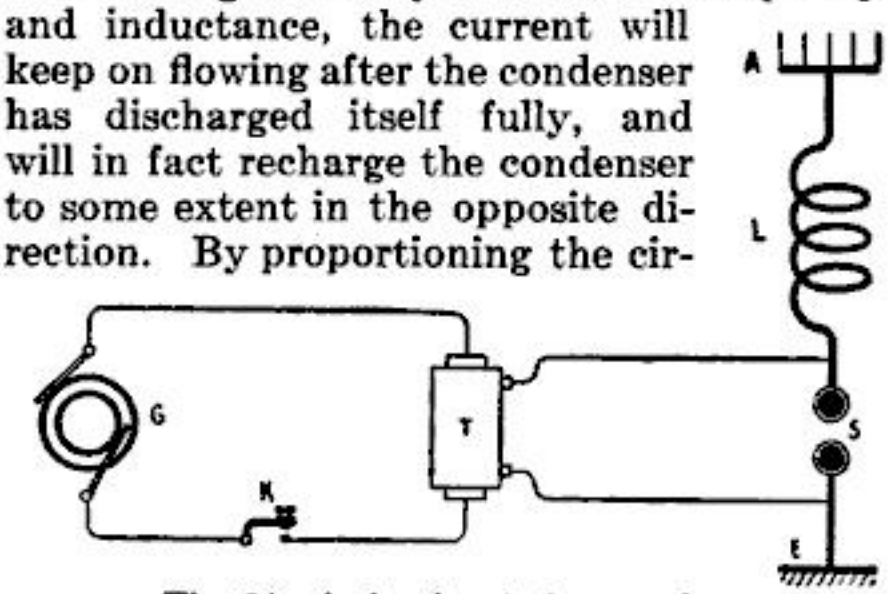


Fig. 31: A simple wireless sender with a loaded antenna circuit

cuit properly, the recharging may be made to reach a value almost as high as the initial potential of discharge. Manifestly, when the second maximum is reached the condenser will once more discharge through the induct-

ance and resistance, but this time in the direction of arrow *Y*. The process is repeated indefinitely, each charge growing somewhat smaller than the one preceding it, but each producing a half-cycle of alternating current, until the energy of the original charge is all used up in heat or useful work. The successive half-cycles in opposite directions unite to produce an alternating current which gradually dies away in strength or amplitude, but whose frequency remains constant. In such a condenser-discharge circuit, the frequency of the current produced depends upon the effective capacity and inductance, and, to a limited extent, upon the resistance. The rate at which the current dies away depends upon the effective values of these same three electrical quantities. The intensity of the current in the first half-cycle of the discharge depends upon the voltage to which the condenser was charged, as well as its size and on the circuit inductance and resistance.

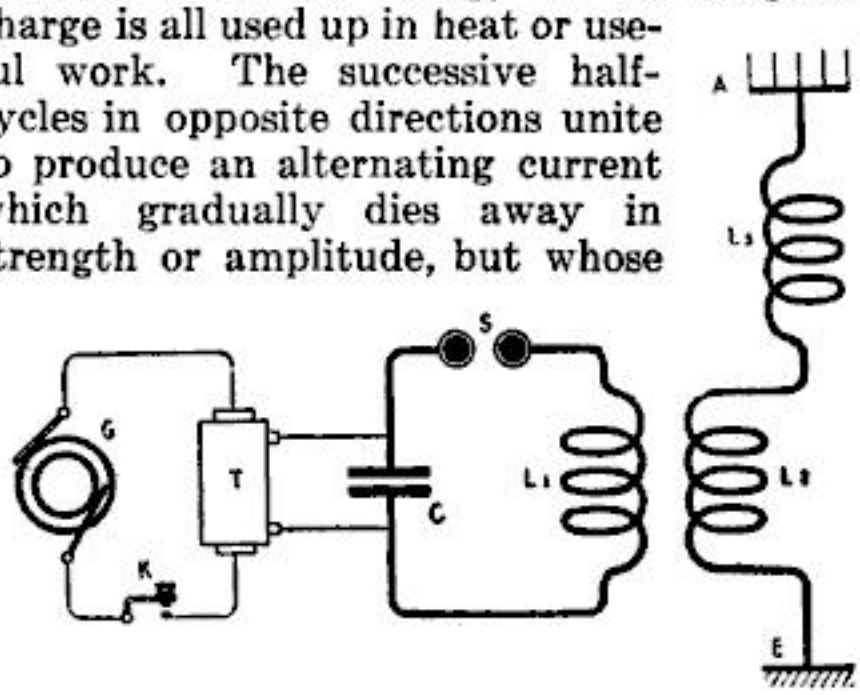


Fig. 32: An arrangement of transmitter depending on condenser discharge in closed circuit

A Simple Radio Transmitter

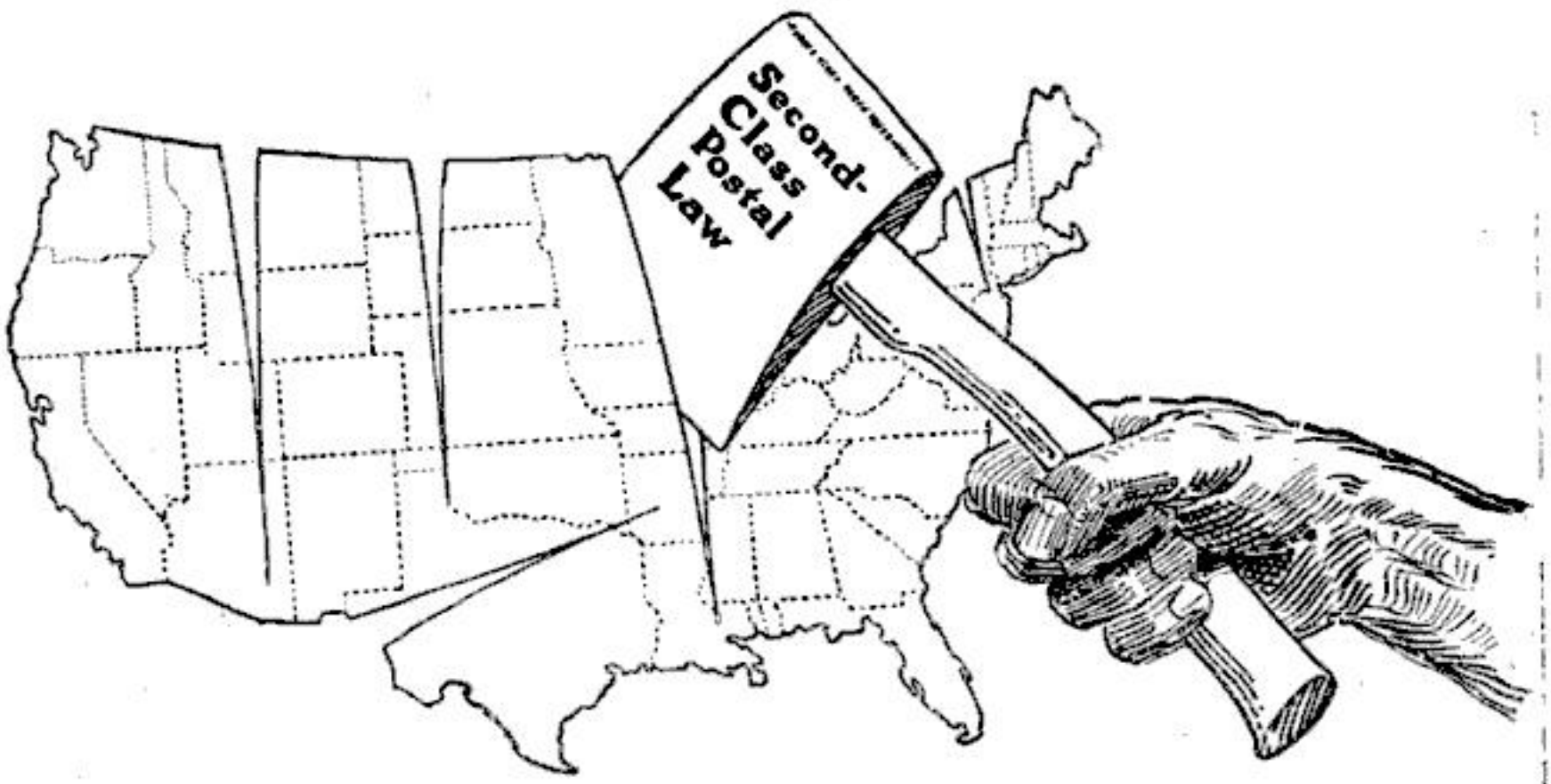
The condenser-discharge method of generating alternating currents is practical for frequencies from a few thousand per second up to millions per second, and is the basis of all radio telegraph transmitters of the spark type. One of the simple ways in which the principle is applied is shown in Fig. 31. A generator *G* of audio frequency alternating current, of say 500 cycles per second, is connected in series with a telegraph key *K* and the primary coil of a step-up transformer *T*. The secondary of this transformer, which produces a high voltage (of perhaps 20,000) at the applied frequency of 500 per second, is connected across a spark gap *S* which lies between the aerial wires *A* and the ground *E*, an inductance coil *L* being in series in this antenna circuit. Each voltage pulse from the secondary of the transformer puts a charge upon the aerial-ground system, since the wires in the air act toward the surface of the earth much as one plate of a condenser acts toward the other. When approximately the highest point of voltage in each charging pulse is reached, the spark-gap *S* breaks down and the voltage established between antenna and earth just before the rupture causes a rush of current through the coil *L* and across the gap *S*. By choosing suitable values for the inductance capacity and resistance, the discharge can be made to overshoot and to recharge the antenna capacity in the opposite direction, just as in the closed circuit of Fig. 4. Thus an alternating current is produced in the antenna-to-earth system. Its frequency is controllable by changing the inductance and capacity of the antenna circuit, and it may be stopped and started by opening and closing the telegraph key. This offers one solution to the first problem of radio telegraphy.

Two-Circuit Spark Transmitter

A type of transmitter which is preferred to that of Fig. 31 is shown in Fig. 32. It also depends upon the condenser discharge for generation of radio frequency current in the antenna. Here a condenser *C* receives the voltage impulses from the transformer, and discharges across the spark-gap *S*. The radio frequency currents thus generated in the closed circuit *S*, *C*, *L*1 induce similar voltages and currents in the antenna circuit *A*, *L*3, *L*2, *E* by means of the transformer action of the magnetically coupled coils *L*1 and *L*2. This is perhaps the most effective form of simple spark transmitter which has been used in radio, and forms the basis of by far the greatest number of radio stations in the world. It produces in the aerial wires a controllable radio frequency alternating current, and so satisfies the primary condition of the radio transmitter problem.

This article has necessarily been in the nature of a review of essentials, and could not offer constructive assistance to the student except in so far as it will help to clarify his ideas as to the underlying principles and relations which exist in the sending apparatus. In the succeeding articles these principles will be explained in further detail.

(To Be Continued)



Splitting Up the Country

DO you know that the postage on your magazines is to be increased by several hundred per cent beginning July 1st, unless you and other intelligent citizens protest strongly enough? It is a huge tax on intelligence.

For many years one cent has carried a pound of publications to any place in the country. This rate on publications is called "The Second Class Rate."

Penalized for Where You Live

In the War Revenue Bill is a clause placing a very high postage rate on the advertising pages of magazines—the rate increasing with the distance carried—in other words a zone system as on parcel post. It now costs about 1¼ cents to carry a copy of POPULAR SCIENCE MONTHLY to the Pacific Coast.

But when the Second Class Postal clause in the War Revenue Bill is in full effect it will cost over six cents to carry one copy of this magazine—over 72 cents a year, as compared with the present cost of 15 cents! Just think of it! The further you happen to live from New York the more postage you will have to pay on your POPULAR SCIENCE MONTHLY and on all the other magazines you read that are printed in New York!

You know that if you bought the contents of one issue of POPULAR SCIENCE MONTHLY in book form it would cost at least one dollar, and probably a good deal more. But you buy POPULAR SCIENCE MONTHLY for 15 cents.

This is made possible by the one-cent-a-pound postage and by the advertisements. To place a huge tax on the advertising pages is to kill the goose that lays the golden eggs.

Why does Congress, now, in the midst of the War, want to throttle the press, the one vital force that keeps the country united? It was by the jugglery of Congressman Kitchin that the Second Class Postage clause was passed as a part of the War Revenue Bill. A little group in the House of Representatives proposed it, the Senate voted it down; then the little group put it back, and insisted. You know how the discussion in Congress on the War Revenue Bill dragged and dragged. Finally, the only chance of passing the Bill was to take it all—hook, line and sinker, including the vicious postage tax on magazine readers—and it was passed!

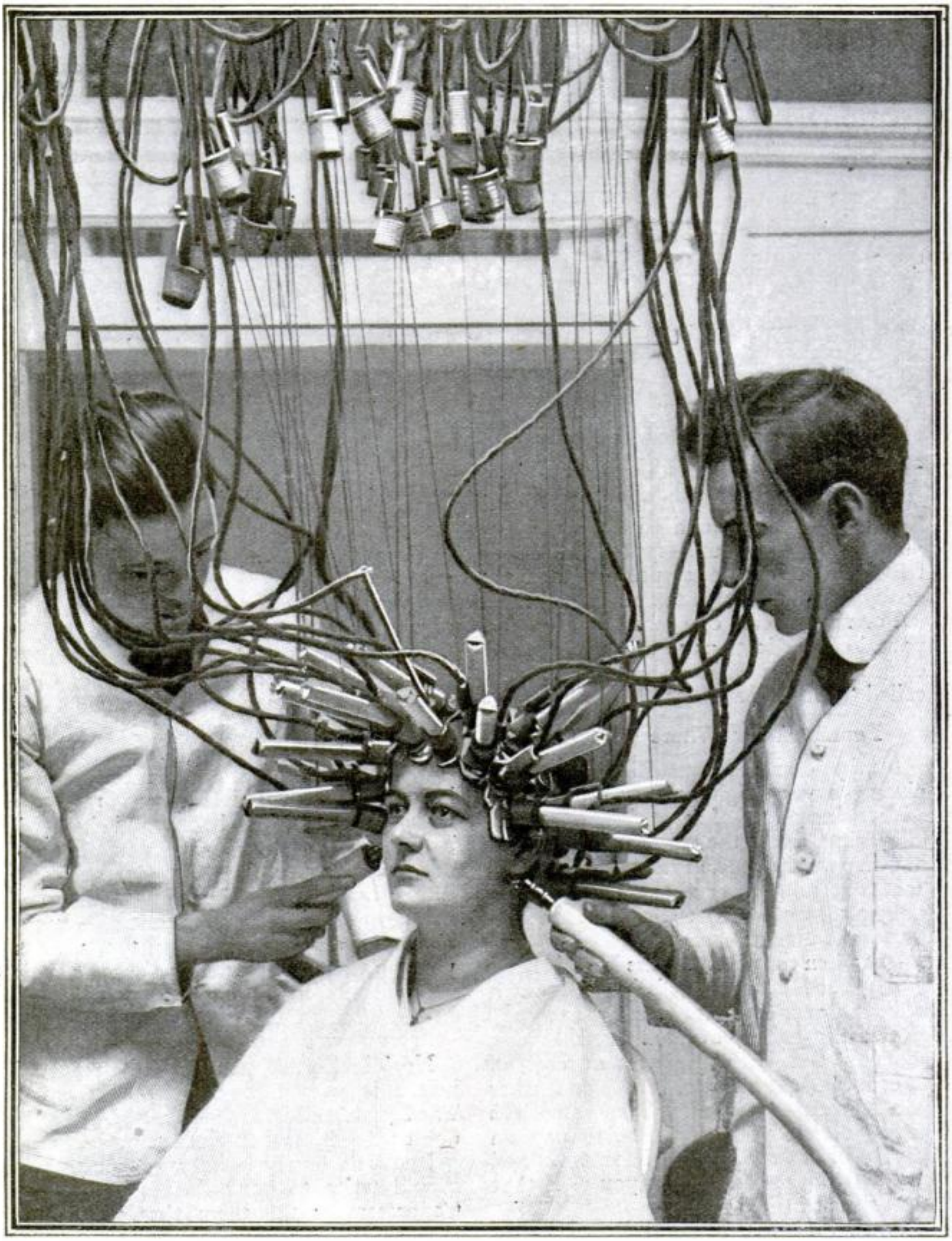
What You Should Do About It

No, The Zone System must be repealed before it goes into effect on July 1st. The Senate thinks it vicious. The people don't want it, and they must protest.

You and every reader of magazines should write to your Senator and your Congressman; tell them that you want the Zone System repealed.

If you want the names of your Senator and your Congressman, or any other assistance, write to the Editor of POPULAR SCIENCE MONTHLY—he will gladly help you.

Man-made Beauty—Electrically Baked Curls



This is not a close-up view of the head of the Statue of Liberty. It is just the picture of a good wife endeavoring to please her husband by having the straight hair he detests turned into the enchanting curls he adores. Her hair is being baked electrically. Ten minutes of this baking and she has curls that defy the straightening effects of shampoos or sea fogs